CONSULTANTS AND CONTRACTORS' PERCEPTION OF CRITICAL SUCCESS FACTORS FOR LARGE CONSTRUCTION PROJECTS

BY

HASAN OSAMA MATHER

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This thesis, written by **Hasan Osama Mathar** under the direction of his thesis advisor and approved by his thesis committee, has been presented and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING AND MANAGEMENT.**

Dr. KHALAF A. AL-OFI
Department Chairman

Dr. Sadi Assaf
(Advisor)

Dr. Salam A. Zummo
Dean of Graduate Studies

Dr. Bambang Trigunarsyah
(Member)

25/5/14
Date

عمادة الدراسات العليا
DEANSHIP OF GRADUATE STUDIES

Dr. Mohammad A. Hassanain
(Member)

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Lovingly,

I dedicate my thesis to my family, for their continuous support during my master study.

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LIST OF ABBREVIATIONS

MCSF	:	Most critical success factors
LBCP	:	Large building construction projects
LCP	:	Large construction projects
MOMRA	**:**	Ministry of Municipal and Rural Affairs

ABSTRACT

Full Name : Hasan Osama Hasan Mathar

Thesis Title : Consultants and Contractors' perception of critical success factors for large building construction projects.

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In the last few years Investment in construction in KSA increased to occupy the highest level in the world, USD 629 billion are the Saudi expenditure on the construction industry in 2013. Because of the huge amount of money spend on this sector and the continuous development in the building technologies in addition to the huge demand on this sector, success for the investment on construction projects become crucial.

This study was established to identify the factors which affect the success of the construction projects and focus on the variation between different perceptions for consultants and contractors regarding the criticality for different factors.

Review for the literature was firstly performed to find factors which have an effect on the project success. Then questionnaire survey was prepared and distributed over 61 experts in the industry from both contractors and consultants firms. Results were used to found the criticality index for each factor and to determine the most critical from the list. Then Mann-Whitney test was used to find if there is significance different between consultants' and contractors' perception or not.

Results shows that 93 factors belong to eight main categories are the factors which have an agreement between different researchers regarding their effect on the project

success. Only twenty factors from the 93 have a large effect on the project success. However only six factors out of the 20 MCSF have problem in the agreement on their criticality between consultants and contractors these factors are: “The impact of the project on the public”, “project size”, “competency and capability of the consultants' key personnel in different disciplines”, “consultant track record”, “clear communication channels between the owner/PM and the designer” and finally, “adequacy of labor resources and their skills".

ملخص الرسالة

الاسم الكامل: حسن اسامة حسن مطهر

عنوان الرسالة: دراسة مقارنة بين وجهة نظر المقاولين والاستشاريين على مدى اهمية مجموعة من العوامل الحرجة التي تؤثر على نجاح المشاريع الانشائية الكبيرة

التخصص: هندسة ادارة التشييد

تاريخ الدرجة العلمية: مايو 2014

في السنوات القليلة الماضية احتل قطاع الانشاءات المركز الاول على مستوى العالم من حيث مقدار الانفاق على مشاريعه حيث بلغ مجمل ما انفقته مختلف الشركات على هذا القطاع ما يقارب 629 مليار دولار خلال العام 2013. بسبب المبالغ الضخمة التي تنفق على هذا القطاع، الى جانب التطور المستمر في تكنلوجيا البناء، اصبح التركيز على نجاح الاستثمار في هذا القطاع عاملا مهما لا بد من دراسته بشكل معمق; لرفع كفائة المشاريع ووزيادة احتمالية النجاح للاستثمار في هذا القطاع.

تهدف هذه الدراسة الى التعريف بأهم العوامل التي تؤثر على نجاح المشاريع الانشائية، اضافة الى دراسة التباين بين اراء شركات المقاولات والشركات الاستشارية على أهمية بعض العوامل التي تعتبر عوامل حرجة من وجهة نظر احدهما او كلاهما.

من خلال الدراسات السابقة تم سرد مجموعة من العوامل التي تعتبر الاهم والأكثر تأثيرا على نجاح المشاريع الانشائية، وبالاستعانة بهذه العمامل تم اعداد استبيان وزع على 61 خبيرا مختصا في مجال صناعة الابنية من كلا الاتجاهين الاستشاريين والمقاولين. و بناءا على النتائج تم تحديد اهم العوامل التي تؤثر وبشكل كبير على نجاح المشاريع. بعد ذلك تمت دراسة التباين بين اراء الاستشاريين والمقاولين على مدى اهمية العوامل الحرجة من خلال ادوات تحليل احصائي مختلفة ومن أهمها مان ويتني.

أظهرت النتائج 93 عامل هي العوامل الاكثر أهمية وتأثير على نجاح المشاريع، وقد تبين أيضا أن عشرين منهم لهم تأثير بشكل كبير وملحوظ على نجاح المشاريع. ومن خلال دراسة التباين بين اراء المقاولين والاستشارين على

اهمية العشرين الأهم تبين أنه يوجد اختلاف كبير وملحوظ بين اراء الاستشاريين والمقاولين على أهمية ستة من هذه العوامل العشرين الحرجة وهي:

"أثر المشروع على الجمهور"، "حجم المشروع"، "كفائة وقدرة الموظفين لدى الاستشاري في مختلف التخصصات."،"سجل الاستشاري والمشاريع المنفذه"، "وضوح قنوات الاتصال بين المصمم, مدير المشرع والمالك."، وأخيرا "كفائة العمالة وتوفر جميع المهرة المطلوبين".

CHAPTER 1

INTRODUCTION

1.1. Back Ground

The improvement of the construction industry in any country is crucial, since it is used as an important indicator for determining the level of the development and prosperous that any country reached in different disciplines, economical, industrial, social, political and other disciplines. Lately the construction industry in Saudi Arabia becomes one of the largest investment sectors in the Kingdome. Youssef, (2013) indicated that Saudi Arabia occupies the highest level of spending in construction projects compared to the other Gulf countries which considered as the most Prosperous countries in the construction market in the world. USD 629 billion are the Saudi expenditure on the construction industry in the 2013 which equal to 42% of the total expenditure on the construction projects in the gulf countries which reached up to USD 1.5 trillion. Because of the rapid improvement in the construction industry and the large number of investors from different nationalities, many obstacles which may affect the success of the construction project could appear. This will affect the investment in this sector in addition to its future improvement. Owners, Consultant, Contractors, and Suppliers have a common goal which is the success in their investment. This goal should

be achieved for all of these participants to end with success project from all participants point of view.

1.2. Problem Statement

The construction industry suffer from many problems such as, lack of trust between different parties, inadequacy of communication between stockholders, weakness of cooperation in addition to other problems which can affect the cost, duration and quality of the construction project and lead to claims which have difficulties in resolving Chan, et al (2004). Success of the construction projects is a mutual concern for all parties involved in the construction work; several procedures should be taken to achieve this desired goal. Many factors which have their percentage share in the construction project success should be determined and analyzed. Saudi construction industry as a Prosperous sector in the region and classified as the second largest sector in the Kingdome has many uncertainties regarding to the project success, the meaning of the project success, what are the most important factors leading to the project success and how can we benefit from considering those factors. Serious actions should be taken to increase the probability of the construction project success in Saudi Arabia.

1.3. Research Objectives

Saudi Arabia as the largest construction market in the world as mentioned by Youssef, (2013) has facing challenges which related to the success of the construction projects. There are different meanings for the construction project success depending on the perception of the concerned party. Owner needs to achieve the project with best performance at minimum cost in specific duration, consultant looking for implementing the design at best quality in addition to achieve the owners' needs, while contractor aims to collect the maximum possible profit.

All of these goals and others should be achieved to end with a successful project from all participant points of view. To achieve the desired goals for all parties involved in the construction work many factors should be followed. Comprehensive study for these factors should be conducted to find the most critical and analyze them to facilitate decision making during construction process.

This research aims to:

1. Identify the success factors for large construction projects.
2. Define the Saudi contractors' and consultants' perception regarding to the criticality for each success factor indicated, and identify the most critical success factors.
3. Analyze the differences between the consultants and contractors perception regarding to the most critical success factor for construction projects. And develop the consensus list of these most critical success factors.

1.4. Limitations of the research

1. The results are limited to the large building construction projects.
2. This research is limited to the Eastern Province in Saudi Arabia this because of the time and budget limitations.
3. This research is limited to the contractors' and consultants' perception regarding to the project success factors.

1.5. Significance of this research

Many studies have been conducted on the success factors for construction projects in Saudi Arabia, few of these studies focus on the most critical success factors and the perception of the different key players in the construction project. This study will develop a comprehensive list of the success factors for construction projects and it will focus on the most critical success factors from the consultants' and contractors' perception only for the large building construction projects.

1. This study will provide the construction practitioners with the most critical success factors in their project.
2. It will provide frame work for increasing the success probability during the life cycle of the construction project.
3. Results can help consultants, contractors and owners to establish partnering relationship and evaluate the level of the success for particular construction projects.
4. It will be helpful in providing lessons learned from different construction projects.

1.6. Research Methodology

The concept beyond project success has different meanings depending on the concerned person as stated by Chan, et al (2004) for this reason the opinion of the parties who involved in the construction process regarding to the success factors is crucial.

1- To achieve the first objective previous researches have been reviewed to identify the most common success factors for construction projects.
2- Questionnaire survey with project participants from different disciplines and experience were distributed to identify the criticality level for each success factor on the construction projects.
3- Using different statistical tools depending on the Criticality Index (CI) to develop two separate lists represent the consultants' and contractors' perception regarding to the most critical success factors for construction projects.
4- By using significance test the difference in perception between consultants and contractors were identified. This is to make sure that the difference is significant.

CHAPTER 2

LITERATURE REVIEW

2.1. Success Factors Definitions

Traditionally, success is defined as the degree, to which project goals and expectations are met, Chan et al (2001). Ashley et al (1987) referred to project success as having "results much better than expected or normally observed in terms of cost, schedule, quality, safety and participant satisfaction". Tuman (1986) suggests a contrary definition of construction project success as "having everything turn out as hoped.

Chan, et al (2004) mentioned that the concept beyond project success still ambiguous and cannot be defined because of the dynamic nature of the construction projects, budget, uncertainty in addition to the complexity in the building technologies. Also they stated that the meaning of the project success varies, since each personal involved in the construction project have different meaning for the project success.

The terminology critical success factors (CSFs) was used firstly by Rockart (1982). He defined CSF as "those few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his or her desire goals". As Rockart (1982) managers should focus on the resources which have a limitation on its availability, usually project time, this resource is the most important indicator for the project success or failure.

On the other hand Kog, et al (2012) indicated that there are three major objectives for construction project should be considered to achieve success project, these objectives are Budget, schedule, and quality. To identify the level of satisfaction for each objective many factors should be studied, which named Critical Success Factors (CSFs). Heravi, et al (2012) indicated that there is no specific definition for the project's success since it is connected to the different goals for stockholders, also sometimes there is different interest for each. Because of that we should define the project success based on the point of view which we should consider. Han, et al (2012) define success factors as those factors which have influence on the project success determination.

Tabish, et al (2011) indicated that the success of the project should not limited to only managing the iron triangle which consist of cost, schedule, and quality, but it expand to satisfy another criteria like eliminate the disputes which can arise during construction in addition to the commitment to the safety norms.

Chan and Chan (2004) reported that the concept of project success is developed to set criteria and standards to aid project participants to complete projects with the most desirable outcomes. The iron triangle (on time, under budget, according to specifications) has been the widely accepted criteria for project success during the last couple of decades.

2.2. Previous Studies

Norizam, et al (2013) Conducted a survey on the critical success factors for the construction management which affect the project success, from the literature it has been found that there are seven categories of the success factors have a direct effect on the construction management success these categories are: “Construction Integration Management, Construction Scope Management, Construction Time Management, Construction Cost Management, Construction Quality Management, Construction Human Resources Management, and Construction Risk Management”.

Hwang, et al (2013) Identified the critical success factors for different objectives in construction projects (time, cost and quality) in addition to the different opinion for different key players (Consultant, Contractor, Owner). 32 (CSFs) have been identified from literature and categorized in four main groups, “project characteristics, contractual arrangements, project participants, and interactive processes” then the relative importance for each factor has been identified using analytical hierarchy process (AHP), for each of the 3 main players involved in the construction projects (Contractor, Consultant and owner) and also for (cost, time and quality of the work). By adopting this process “budget performance, schedule performance, quality performance, and overall project success” can be identified from the perspective of each one of the project key players.

Alzahrani, et al (2013) conducted a study on the critical factors that affect the success of the construction project by studying and evaluating projects after the construction phase, 35 success factors have been identified and categorized under 9 categories, these categories are, safety and quality, past performance, environment, management and technical aspects, resource, organization, experience, size/type of

pervious projects and finance. These factors give us an impression about the contractors' attribute. By using logistic regression techniques to establish a model for measuring the likelihood of the project success, it has been found that the most critical factors which affect the project success are: "turnover history, quality policy, adequacy of labor and plant resources, waste disposal, size of past projects completed, and company image".

Al-Shibly, et al (2013) studied the effect of risk management on the project success. It has been found that there is a relation between risk identification and assessment from hand and project success from the other way. On the other hand claims can't be avoided by risk assessment. Also respond to the risk has there is a good influence on the project success.

Chou, et al (2013) established structural equation model to study the effect of using tools, techniques and skills (TTSs) of the project management body of knowledge (PMBOK) on the construction project success. It has been found that the likelihood of the project success will increase while using the (TTSs) of the (PMBOK), in addition to the possibility of increasing the probability of the project success by developing the management knowledge which depends on (TTS). The involvement of the PMBOK consists of

1. Project success PS index (PSI), a framework which has been adapted by the satisfaction index of the American Customers, in addition to the importance-performance analysis (IPA) for the critical PMBOK TTS predictors of the PS,
2. Implementing efficient strategies for management by identify PMBOK TTS which affect the project success, by using IPA technique; this can improve project performance, in addition to the improvement of the resources management efficiency.

3. Different personal who are involved in the field of the construction engineering should have an instructions for using PMBOK TTS.

Pakseresht, et al, (2012) Indicated that in the construction projects there are several factors lead to successful project. Analytical hierarchy process AHP has been used in analyzing the priority of the success factors which have been identified for the survey; this survey has been distributed over 15 experts in the construction industry. Based on this study it has been found that the most critical success factors are:

- The assessment of the technical and economical aspects of the resources needed for project,
- Past experience for the project managers,
- The strategies for project planning and the contractors experience in the implementation of the project type.

Yong, et al (2012) Conducted a study on the success factors for construction projects. Relative importance for each factor has been determined according to the respondents. 15 success factors have been accepted as the most critical from the 7 categories which consist of 37 success factors, also it has been found that there is uniformity in the respondent perception regarding to the importance of the factors related to human issues like, "competence, commitment, communication and cooperation towards the success of a construction project". These factors are the most important in the procurement which based on relationship in the construction industry in Malaysia.

Chen, et al (2012) established critical success factors (CSFs) system by produce 46 CSFs out of the 62 CSFs mentioned in the literature review. These factors categorized into three main categories, Participant-related factors consist of 5 subcategories, Project-

related factors consist of two subcategories, and Environment- related factors, categorized into three subcategories. In this research data have been collected through questionnaire survey conducted over one hundred twenty four projects to generate the hypothetical model. Also this research aims to apply structural equation model (SEM) for the purpose of identifying the interrelation among the CSFs which will make it easier to control the factors lead to successful project.

Kog, et al (2012) Tried to differentiate between the critical successes factors for construction project from different disciplines perspectives, architectural, structural, electrical, mechanical, and quantity surveyor. 10 critical success factors from group of 67 factors have been identified as the most critical by using the analytical hierarchy possess (AHP) to obtain subjective judgment from 27 expert personal in the construction industry. This study shows that adequate plans and specification in addition to the competency of the project manager are two of the most critical success factors for budget, performance, and quality from the perspective of the architect, civil, structural, and "electrical and mechanical" engineers. It has been found that there are obvious differences between different disciplines perspective regarding to the top 10 (CSFs), also there are differences in the judgment between the respondents who have more than 15 years of experience and those who have less experience.

Inayat, et al (2012), conducted a study to compare between different organization background opinions regarding to the construction project success factors. A survey has been distributed over construction professionals from different disciplines in the construction industry architects, civil/structural engineers, mechanical engineers, electrical engineers, and quantity surveyors, and also from different organizations

Contractors, Consultant and Managers to rank 53 success factors for construction project. It has been found that there are many differences in the relative importance for the success factors from the different perspectives, although there is a consensus on some factors, like the latent site conditions and its effect on the schedule and budget performance.

Heravi, et al (2012) established a model for evaluating the success for construction project from the contractors' perspective. To establish this model comprehensive definition for the project success is used this definition includes two components, the first is the product success which means the final product, and the second is the success of the project management which concerned about the project and construction process. Then 5 steps should performed to obtain the final results which includes "Identification of the critical performance indices for the two above mentioned components, Quantification of the performance indices, Normalization of the indices, Integration of the various performance indices to develop an overall project performance function, Applying the model on a real project in Iran and analyzing the results". It has been found that the resulted model can be used for measuring contactors' performance in the construction project, in addition to its efficiency in defining the contractors' strength and weaknesses.

Han, et al (2012) suggested a framework which can use to determine the relationship between different success criteria and construction project success factors. They adopt the literature review as a process for their research; it has been found that the critical success factor or critical success criteria are essential in getting lesson learned.

These lessons should be documented to increase the success probability for future projects.

Tabish, et al (2011) indicated that most important step for achieving the success for a particular project is the identification of the critical success factor for this project, 36 success factors have been identified and tested by distributing questionnaire over the construction professionals to determine the criticality of each success factor on the public construction projects in India. Critical success factors have been categorized into two main categories the first is the factors of generic nature, "owners need thoroughly understood and defined a high degree of trust shared by project participants, timely and valuable decision from top management, availability of resources as planned throughout the project, top management's support, and regular monitoring and feedback by top management". The second category is the factors which related to specific nature, "thorough understanding of scope on the part of project manager and contractor, comprehensive pretender site investigation, regular monitoring and feedback by owner, no bureaucratic interference, no social and political interference, clearly articulated scope of work, quality control and quality assurance activities, and adequate communication among all project participants". It has been found that the results are useful in measuring the project completion success.

Toor, et al (2009) Obtained the construction professionals perception on the factors which lead to the successful for large construction projects. These factors have been identified based on questionnaire survey in addition to interview with the construction practitioners. It has been found that "project planning and control, project personnel, and involvement of client" are critical to the success of the large construction

projects in Thailand. Also there is a concern for practitioners on the "sufficient resources, adequate communication, mutual understanding of stakeholders on project goals, and award of bids to the "right" designers and contractors".

Elwakil, et al (2009) developed a model which is helpful in determining the performance of any construction organization based on the most critical success factors. These factors have been identified and categorized in 4 groups namely Administrative and Legal related factors, Technical related factors, Management related factors and Market and Finance related factors. Each factor has a relative importance depending on its contribution to the project success. These results can be used by managers to increase the profit, and improve the performance of the organization by suggesting corrective actions.

Toor, et al (2008) Studied the relationships between the factors which have an involvement on the success of the large-scale construction projects. The effect of these relationships on the large-scale project success has been studied. Questionnaire survey consists of 39 success factors and interviews with construction professionals have been conducted. Factor analysis also has been conducted to study the relationships between different success factors. The result framing four groups of success factors which named the four (COMs), Comprehension, Competence, Commitment, and Communication, respectively. These groups facilitate understanding the success factors of the construction projects, in addition to its ability to be used by project managers to evaluate projects success.

Yu, et al (2006) Conducted a study on the critical success factors for construction projects as they contribute to a successful briefing. Thirty seven Critical success factors

have been identified and categorized in five major groups namely, “project related factors, human related factors, process related factors, input related factors, and output related factors”. Questionnaire survey has been distributed over the construction professionals to collect their opinions regarding to the relative importance for each success factor. It has been found that “open and effective communication” occupies the most critical factor to briefing followed by “clear and precise briefing documents,” “clear intention and objectives of client,” and “clear project goal and objectives”.

Chan, et al (2004) developed a framework for the groups of factors that affect the project success, For collecting data Authors relied on reviewing 7 major management journals which occupy the highest rank in the management journals. Five major groups of the separate variables have been identified, namely “project-related factors, project procedures, project management actions, human related factors, and external environment”. It has been found that these are the most important variables for the project success.

Chan, et al (2004) developed a framework to measure the level of the success for the construction projects. Also they identify a set of the key performance indicator (KPIs) from the literature which can be measured in two ways the first is the subjective measurement using personal opinion and judgment. The second is the objective measurement which uses mathematical equations for measuring different values. The veracity of these (KPIs) has been examined through three case studies. As a result of this study the performance of the construction project can be measured using these (KPIs).

Nguyen, et al (2004) Distributed a questionnaire survey over 109 respondents related to 42 Construction Company, to rank the criticality of different success factors.

These success factors have been categorized after they have been analyzed into four main categories (four COMs) competence, communication, commitment and comfort. The research results can help construction practitioners to increase the probability of the project success by encourage the team work spirit and ownership recognition. Also advisory tool for project management which based on these success factors can be developed.

Shields, et al (2003) established a scale to measure the level of success for any construction project during the construction phase. The characteristic for this scale is quantitatively derived and focus only on one phase during project life cycle. Data for this study have been collected from the database of the CII Benchmarking and Metrics. 209 projects data from different disciplines in the construction industry have been studied. The result of this study was an empirical equation which can be used to measure the success of the construction projects by giving values ranged from 0-10 depending on the performance of the projects' owner and contractor in different variables consist of: growth of the construction cost, growth of the construction schedule, rework factor, and lost working days.

Davies (2002) used different ways to decide which factors are critical to the project success based on answering three questions, these questions are, "What factors lead to project management success?'', ''What factors lead to a successful project?'' and ''What factors lead to consistently successful projects?''. 70 construction organizations from different nationality were the target of this research. The results of these three questions were defining a group of 12 success factors which leads to successful project.

Chan, et al (2001) conducted a study on the construction projects success factors and the relative importance for each factor. Six main success factors have been identified by using questionnaire survey which distributed for 53 participants from the public sector. Then these data have been analyzed. The resulted six factors are: "project team commitment, contractor's competencies, risk and liability assessment, client's competencies, end-users' needs and constraints imposed by end-users". By using multiple regressions it has been found that the most important factors affecting the success of the project are: "Project team commitment, client's competencies, and contractor's competencies". Also emphasis on the team work and partnering is important to achieve successful project.

Chua, et al (1999) Conducted a study to differentiate between success factors for different projects objectives, budget, quality, and schedule. Questionnaire survey has been developed to collect data regarding to the project success factors from the construction professionals. The relative importance of the construction project success factors have been determined using analytical hierarchy process (AHP). Success factors have been categorized into four main categories namely; "project characteristics, contractual arrangements, project participants, and interactive processes" these categorize include 67 success factors. It has been found that the characteristics of the project and the contractual arrangement should be taken into account in addition to the Project management, Monitor and control while using the equation for measuring the project success.

Assaf, et al (2013) conducted study to evaluate the criticality level for different factors on the construction projects. Twenty six success factors have been identified by

interviews with engineers, procurement and construction contractors, in addition to the literature. Then the criticality for each success factor was examined by the criticality index which has been calculated from the response of the 25 participants in the survey. Results shows that nineteen success factors have been found very critical on the project success and the most critical from them were: “clearly defined project objectives and scope", “experience and competent project manager”, “project team commitment to meet the cost and quality”, “effective communication system”, and “coordinating skills of the project team leader”.

Ali, et al (2013) studied the factors which have a great effect on the success of construction projects in the Libyan industry. Experts and professionals practitioners were participate in the survey and rank different factors depending on their criticality on the success of the construction projects. results shows that the most critical factors were: “consideration and implementation of procurement and tendering methods”, “ decision making and clearly defined project objectives”, “together with leadership”, “project management performance and the utilization of advanced technology”.

2.3. Success factors categories

Toor, et al (2008) indicated in his research that the construction industry has different and complex working conditions for each project. There are a lot of variables which share to the project success and completion. Such as human variables budget constraints in addition to the technical variables, from the literature review it has been found that there are different ways to categorize the success factors for construction projects. The following table shows the CSFs categories as indicated by different researches.

Table 2- 1 Success factors categorization in previous studies.

Norizam, et al (2013)	**Hwang, et al (2013)**	**Chua, et al (1999)**
project integration management	Project characteristics	Project characteristics
project scope management	Contractual arrangements	Contractual arrangements
project time management	Project participants	Project participants
project cost management	Interactive processes	Interactive processes
project quality management		
Project human resource management		
Project communications management		
project risk management		
project procurement management		
Others management factors		
Alzahrani, et al (2013)	**Kog, et al (2012)**	**Inayat,et al (2012)**
Health, safety and quality	Project characteristics	Project characteristics
Past performance	Contractual arrangements	Contractual arrangements
Environment	Project participants	Project participants
Management and technical	Interactive processes	Interactive processes
Resources		Miscellaneous
Organization		
Experience		
Size/type of pervious project		
Finance		

Table 2- 1 Success factors categorization in previous studies. (Cont).

Tabish, et al (2012)	**Elwakil, et al (2009)**	**Toor, et al (2008)**
1. Human factors	Administrative and Legal	Comprehension
Project manager's competence	Technical	Competence
Commitment of all project	Management	Commitment
Owners competency	Market and finance ance	Communication
Good coordination between project participants		
Availability of trained resources		
2. Management actions		
Monitoring and feedback by project participant		
Regular budget update		
Yu, et al (2006)	**Chan, et al (2004)**	**Chan, et al (2004)**
Project-related factors	Project management	Meeting design goals
Human-related factors- (Client,	Project procedures	Benefit to the defense and
Process-related factors	Project related factors	Benefit to the developing
Input-related factors	External environment	Benefit to the end user
Output-related factors	Human related factors	
Nguyen, et al (2004)	**Chan, et al (2001)**	
Comprehension	Project Team Commitment	
Competence	Contractor's Competencies	
Commitment	Risk and Liability	
Communication	Client's Competencies	
	End-Users' Needs	
	Constraints Imposed by	

The broader prevalent way in categorizing success factors which firstly used by Chua, et al (1999) in their research success factors have been grouped in four main categories as shown in figure no.4. Also they indicated that there are other objectives for the construction project in addition to the traditional objectives Cost, Schedule and Quality, such as market entry and safety consideration, these goals and their relative importance depends on the company interests. To achieve these desire goals successfully many factors which named Critical Success Factors (CSFs) should be taken in consideration to optimize the use of the available resources, manpower, money and time in addition to the appropriate allocation for them.

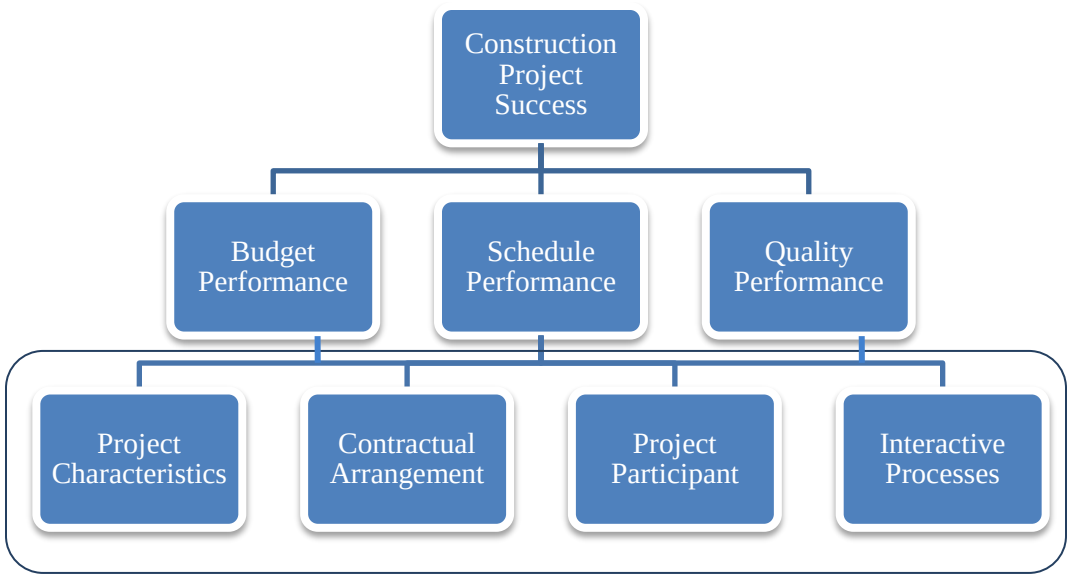


Figure 2- 1 Hierarchical Model for construction project success. Chua, et al (1999).

As shown in Table 2.1 there are some variation between researchers regarding to the categorization for success factors for construction projects depending on their

objectives. Also it has been found that there is a consensus on some of the categories between some of the previous studies as shown in figure 2-1.

Depending on the previous studies and the need of comprehensive coverage to the factors affect the success for construction projects. Many other factors which are available in previous researches can't be listed under any of the four categories. Another 4 categories which found suitable to include those factors have been defined from the literature as following:

Finance Alzahrani, et al (2013), Elwakil, et al (2009).

Management and technical: Alzahrani, et al (2013), Elwakil, et al (2009).

Experience: Alzahrani, et al (2013), Norizam, et al (2013), Tabish, et al (2012)

Health, safety and quality: Alzahrani, et al (2013), Chan, et al (2001), Norizam, et al (2013).

Based on the previous agreement on the factors categorization 8 categories for the success factors which include most of the success factors for construction projects were developed to be used in this study.

1. Project characteristics.
2. Contractual arrangement and administration.
3. Project participants.
4. Interactive process and communication.
5. Finance.
6. Management and technical attributes.
7. Experience and resource attributes.
8. Health & quality attributes.

2.4. Success factors and success indicators

Chua, et al (1999) identified the meaning of these terms by the following scenario. The main goal is achieving successful project, the criteria's or indicators by which the project success can be measured are budget, schedule and quality. Also these indicators considered as the project objectives to achieve the desired goal. The success factors are grouped under different subcategories and reflect the project conditions which affect achieving these objectives.

Table 2-2 shows the most important indicators for project success based on what have been found in the previous studies. It has been found that the most effective indicators for project success are: complete on time, within budget, meeting quality requirements, and also design requirements, stakeholder satisfaction, recurring business, and overall project success.

Table 2- 2 Measures of Project Success, Chou, et al (2013).

Project success indicator	Supportive literature
Completed on time	Angela (1999), Belout and Gauvreau (2004), de Wit (1988), Doloi et al. (2011), Dvir et al. (2003), Kerzner (2009), Konchar and Sanvido (1998), Molenaar et al. (2000), Milosevic and Patanakul (2005), Papke-Shields et al. (2010), Zwikael et al. (2005), Muller et al. (2012)
Completed within budget	Angela (1999), de Wit (1988), Doloi et al. (2011), Dvir et al. (2003), Kerzner (2009), Konchar and Sanvido (1998), Molenaar et al. (2000), Milosevic and Patanakul (2005), Papke-Shields et al. (2010), Zwikael et al. (2005), Muller et al. (2012)
Meet quality requirements	Angela (1999), de Wit (1988), Doloi et al. (2011), Dvir et al. (2003), Kerzner (2009), Konchar and Sanvido (1998), Milosevic and Patanakul (2005), Papke-Shields et al. (2010), Muller et al. (2012)
Meet design requirements	de Wit (1988), Dvir et al. (2003)
Stakeholder satisfaction	de Wit (1988), Dvir et al. (2003), Kerzner (2009), Zwikael et al. (2005), Chan and Chan (1999), Ling et al. (2004), Molenaar et al. (2000), Milosevic and Patanakul (2005), Papke-Shields et al. (2010), Muller et al. (2012)
Recurring business	Muller et al. (2012), Scott-Young and Samson (2008)
Overall project success	Doloi et al. (2011), Dvir et al. (2003)

Also Davies, (2002) defined the success criteria as the measures based on which the project success or failure is judged; while the success factors are those entered into the management systems and result in project success directly or indirectly. Chan, et al (2004) define the success indicators as a group of rules and standards which considered as the reference for the outcomes which should be gained after the project completion, Figure 2-2 shows KPIs for project success.

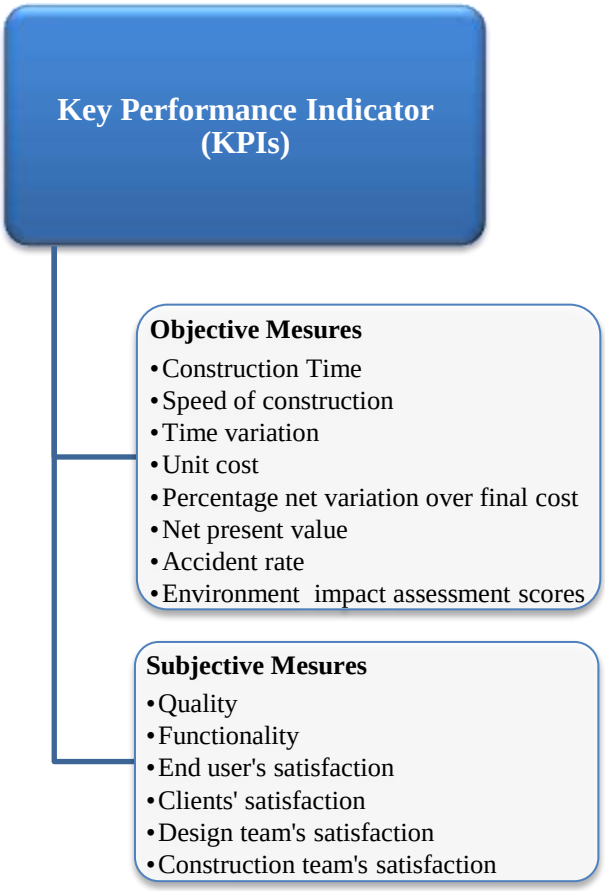


Figure 2- 2 KPIs for project success. Chan, et al (2004).

Because of the variation of interest for the involved parties in the construction projects a consensus frame work for all of these parties should be set. Figure 2-3 present the group of the indicators which can be measured to examine project success.

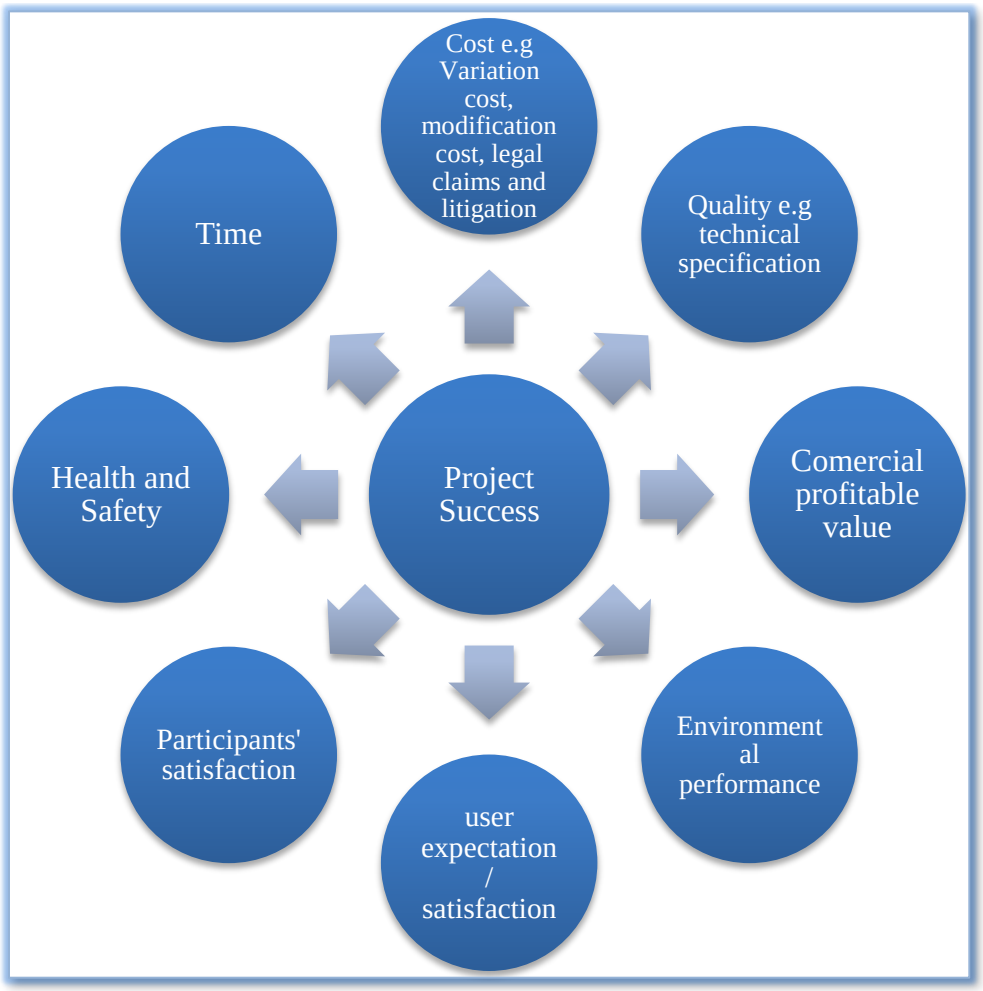


Figure 2- 3 consolidated framework for measuring project success, Chan, et al (2004).

Toor, et al (2010) Identified the perception for the parties who involved in the construction projects among the Key Performance Indicators (KPIs), and rank them according to their relative importance from the respondents perspectives the following triangle shown in Figure 2-4 identify the performance criteria for mega projects.

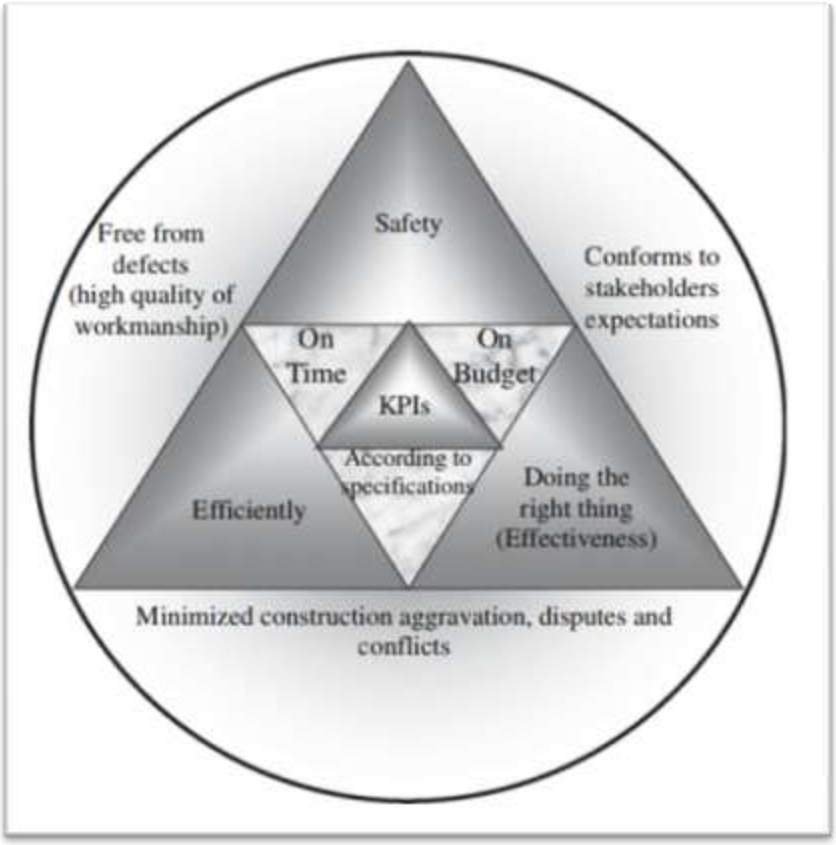


Figure 2- 4 Performance measurement criteria for mega projects. Toor, et al (2010).

CHAPTER 3

FACTORS DEFINITIONS

3.1. Project characteristics

1. The impact of the project on the public

The extent of public acceptance of the project. In addition to their need to such projects. The project acceptance by the public is an important factor which becomes part of the motivation strategies to complete the project successfully.

2. Technical approval authorities

Any project is required some formal transactions before start performing the job. The ease of the technical and formal procedures in getting these approvals has a greater effect on the project success by reducing the time of getting approval transactions which also reduce the cost of the waiting time.

3. Adequacy of the allocated funds

The progress of any construction project required continuous fund for those different activities executed during the project. Adequate fund for those activities is critical for the success of the contractor in his projects. To provide adequate funds for a particular project financial mechanism is required to manage these payments. Hwang, et al (2013).

4. Site limitations and location

The availability of the services in the construction site is an important issue. The access for these services such as (transportation, telecommunication, electricity, water, etc) affects directly the success of the project. It is important to evaluate the limitation on the site in an earlier stage to manage these limitations efficiently.

5. Use of constructability analysis

Constructability can be defined as the best way of utilizing resources, experiences and technologies. To minimize the probability of rework and the difficulties for the startup. This can saves cost and time without affecting the required quality for the project, and also it can support the safety by increasing working efficiency. Hwang, et al (2013).

6. Project size

Cost, duration and or required resources are the major indicators for the project size. These indicators reflect the degree of the project complexity which also determines the control technique which should be used to monitor and control the construction process. The success for any construction project depends on the success control over the project cost schedule and quality, and as the project become larger the achievement of these goals become harder and harder. Ghasabeh, et al (2010)

3.2. Contractual arrangements and administration

7. Realistic obligations/clear objectives (Clear Vision, Mission and Goals).

The scope of the project should be identified clearly by the entire project participant. By identifying the project goals the process of the construction become clear and oriented towards the required results. Also these consensus goals make the control process over the project more efficient and precise. At the end the level of success of a particular project should take the achievement of the desired goals in account when measuring the project success. Hwang, et al (2013).

8. Adequacy of plans and specifications.

Plans as well as specifications are considered part of the contract documents, Plans shows the relations between different spaces in the project and its related dimensions in addition to the required details. On the other hand specifications are the written information and description for each detail can't be described in plans and drawings. And as the adequacy of these drawings and specifications increased, the estimated cost and required duration to complete the project become more accurate. These accurate details can eliminate the uncertainties which can be appeared during construction. Also it can reduce the probability of claims, change orders and disputes, during the project life cycle. Hwang, et al (2013).

9. Formal dispute resolution process.

Construction projects have many uncertainties because of the complexity and uniqueness for each project. Usually contract documents include some provisions for contingencies. But these provisions are no way to cover all the situations since some of the situations can be expected and others can't. For this reason there are many ways to resolve these disputes formally such as arbitration and litigation although their high cost. Cheung (1999).

10. Contractual Motivation/Incentives

Because of the continuous stresses on the involved parties during the project execution, the motivation become important to encourage those parties to execute the project on time with high quality and less claims. Usually one of the most important incentives for contractors and other project participant is the financial motivation. This gives contractors opportunity to increase their profit and effectiveness. Hwang, et al (2013).

11. Competition strategy.

To execute any project competition between different entities is the most efficient tool to select the best entity to perform the work. Many strategies for competitions can be adopted to win the competition such as Low bid, High tech, Management innovation, longer term of warranty and others. Tan et al (2010).

12. Organizational chart.

Organizational chart is graphical representation for the relation between different officials within the company, or between officials from one company with others in another company. Also this chart can indicate the relation between different departments in the organization. Haskell et al (1922). These charts can facilitate the communication between different construction organizations to increase the success probability for the companies' projects.

13. Comprehensive of the site investigation before tendering.

Site inspection can be defined as the process of gathering information about the project for the evaluation and reporting processes. This process should be continuous during the construction process to ensure the quality of the performed work and avoid rework; this will reduce the disputes and claims which may rise during the construction phase. Hwang, et al (2013).

14. Impartiality in awarding bids to the right designer/contractor.

Project owner should give the same opportunity for all contractors to compete and awarding the tender. This will show the fairness in handling tenders. Treasury Board of Canada Secretariat (2003). Also after awarding the bid to the contractor or designer, committee should identify their decision.

15. General tolerance to corruption.

Corruption is the misuse of the position to achieve personal benefits. This will affect all people who depend on the justice. The tolerance with the corruption has a direct effect on the success of the construction projects by affecting the time and cost and quality of the performed work.

16. Little change in client's requirements during construction.

Sometimes the requirements for the client changes due to different reasons, in some cases this change happens during design stage. In other stages it happens during the construction phase. These changes should be controlled to satisfy clients' requirements and reduce its effect on the cost, time and quality.

17. Thorough assessment of the contractor's proposal.

All proposals which submitted by the contractors to the owner should be evaluated thoroughly. This because each contractor adopt specific strategy in the competition so the thorough assessment can increase the precision in the decision making regarding to the awarding procedures.

3.3. Project Participants

3.3.1. Project Manager

18. PM competency, authority and involvement.

Competency of the project manager in handle such projects, in addition to the powers conferred upon him in taking decision during the process of the construction are very important for the project manager to solve problems which appears during design or construction phase.

3.3.2. Client

19. Client experience in dealing with construction projects.

PM is the representative for client during design phase as well as construction phase. But sometimes clients himself has the experience to handle and take decision regarding different issues in the project. In this situation it is important to test whether this experience affect the project success or not.

20. Client's understanding of the scope of work before advertising for bids.

Scope of work is the part of the work to be performed as mentioned in the contract in order to complete the project, business dictionary. These parts of the work should be broken down into activities with deadlines. Client should understand the parts of his project before advertising for bid.

21. Capability of the client and his key personnel

The key personnel for the client should be capable to perform their work based on the clients' requirement. In addition to their ability in taking decisions regarding different issues in a timely manner. Also they should be able to follow the execution of the project to complete on time, within budget and according to the specified quality.

22. Client track record

The executed projects for the client give indication about his performance in handling his projects. This track record is important for those consultants and contractors to choose the best strategy for dealing with the client and satisfy his requirements.

3.3.3. Contractor

23. Competency and capability of the contractors' key personnel in different disciplines.

Based on the contractors' working field he should have qualified personal in different disciplines related to his work. This is crucial to improve the way of handling projects during construction to increase the probability of achieving the desired goals complete on time within budget and according to the quality.

24. The contractor's understanding of the design process.

Design process is a complicated and iterated process including different relations as indicated in Figure 3-1 Contractors should understand this process to enhance his ability in evaluate the design documents starting from the bidding stage. In addition to understand the designer’s way of thinking during this process and how to improve it by giving feedback from the site experience.

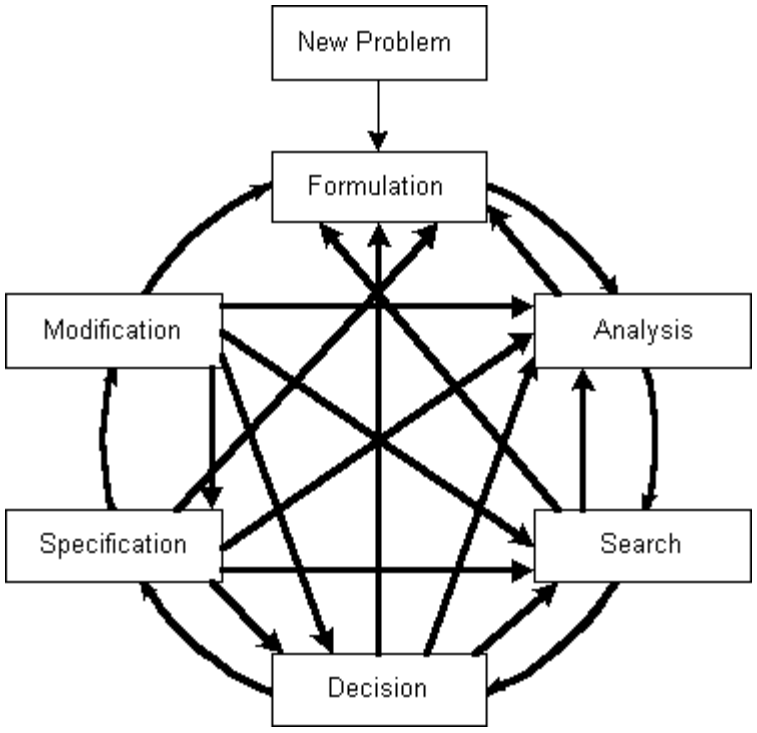


Figure 3- 1 Conceptual Design Process, Jensen et al, (1979).

25. Contractor track record.

The record for the contractor reflects his strength and his ability in dealing with different types of projects. Also it gives a brief about the behavior of the contractor in his previous projects.

3.3.4. Designer

26. The architect’s capability for achieving the client's requirements within budget and schedule.

Time and cost form the most important concern for clients in construction projects. Because these resources have a limitation on their availability, designers (Architects) should be capable to satisfy the clients’ requirements in their designs. This can’t be achieved without having a suitable experience in the construction process.

27. Skillful guidance and advice from the architect.

As mentioned in Factor 26 designers should have the construction experience to satisfy the clients’ requirements. This also enhance his ability to guide and advice other parties who involved in the construction process to end with a successful project.

28. Competency and capability of the consultants' key personnel in different disciplines.

The capability of the consultant key personal includes his experience in dealing with similar projects, his public relations, commitment, control, and many other things. Also the consultant key personal should have the authority from his agency to deal with different parties and take decisions regarding to different issues like performance, cost, and schedule in addition to other major technical issues. Hwang, et al (2013).

29. Consultant track record.

The consultants' track record (C.V) reflects their strength and ability to satisfy the requirement for different clients in different types of projects. In addition to its efficiency in making client relax when his consultant has an excellent track record.

3.3.5. Suppliers.

30. Competency and capability of the suppliers' key personnel in different disciplines.

Construction materials are the main component of any construction project. Many suppliers are working to provide different types of materials for the construction industry. Since the construction industry continuously improved in the technologies and materials used in projects, suppliers should be capable to provide new materials available in the market with the best price and quality. For this reason suppliers should have capable personal in different disciplines related to their specialty.

31. Supplier track record

The consultants' track record (C.V) reflects their strength and ability to satisfy the requirement for different clients in different types of projects. In addition to its efficiency in making client relax when his consultant has an excellent track record.

3.3.6. End user

32. Full understanding of the end users' requirements

Managing and understanding of the project end users requirements is a difficult task since group has different goals. To consolidate these goals barriers which related to

social and institutional issues should be eliminated. Pemsel, et al (2010). At this stage designers start communicate and understand the need for the project end users.

3.3.7. Project participants

33. Commitment of all project participants to the established schedule and budget.

All project participants should work together to complete the project on time and within budget. This required from the participants to eliminate obstacles which may affect the construction process. Also it is important to consider the established schedule and budget as a reference for all parties.

34. Good coordination between project participants according to the organizational chart.

It has been mentioned before that organizational chart is a graphical representation of the relation between different officials in the same company, or between different officials from different companies, Haskell et al (1922). Also coordination in construction projects is crucial since it is the process in which we can manage resources in effective way, Hossain, (2009). As the efficiency of the coordination increased and connected to the organizational chart for different entities involved in the process, as the achievement for goals become easier.

35. Development of an agreed upon framework for executing the project.

Project execution required accurate planning for different tasks and the way which will be adopted for the execution process. These ways should be agreed by all

participants, client, consultant, project manager and contractor to facilitate the execution management for the project. Also it is important for any modification occur during any stage.

36. Clarity of the stakeholder's roles.

Stakeholders are all of the personal who participate and contribute to enhance the work of their firm and achieve its desired goals. These stakeholders are considered the human resources in the firm which required to be managed effectively. Managing these resources required clear definition for their responsibilities.

37. Balance of the different stakeholders requirements.

Once all responsibilities for stakeholders in the firm clearly defined, achieving their requirements become crucial. Sometimes the requirements for different stakeholders contradict, this required balance these requirements to achieve equity in the firm.

38. Sharing of common project goals among all project participants.

Reaching success for any project which has different participants required common goals to be achieved for all participants. Success is considered common goal for all participants but as Heravi, et al (2012 there is no specific definition for the project's success since it is connected to the different goals for stockholders. From this point it is important to search for common objectives for different parties to establish base for the project success.

39. Sharing of a clear understanding of functional and technical requirements among all project participants.

Each party involved in the construction process has different requirements to perform his job. Some of these requirements are technical such as “how to build things” and some others are functional requirements such as “what is this built for”. So all participants should understand others requirements, to facilitate the achievement of his need which considered requirements for project success.

40. Sharing of a high degree of trust between all project participants

The level of trust between project participants should be enhanced by using techniques leading to trust, such as (applying total quality management, partnering relationship, and team building). As indicated by Soares, (2012) distrust should be changed into trust by handling trust as a set of moral values which should be developed inside the human.

3.4. Interactive processes and communication

3.4.1. Feedback

41. Monitoring and feedback on the project

Monitoring is a process of gathering different types of information about specific project. Then these data which has been collected should be analyzed in order to assure the accuracy of the executed works and take corrective actions if needed.

42. Knowledge feedback from the contractor to the design team.

Designers should take benefits from the executed projects to increase the reliability of their designs, in addition to reduce the deficiencies which may appear in the design during the construction process. So any problem which may appear during the construction phase should be archived and used as feedback for the designer to eliminate such problems in other projects.

3.4.2. Control of process

43. Adequacy of the planning and control techniques

Adequate planning and control techniques have the power to avoid many unexpected problems which may appear during the construction process. This will also reduce the probability of the rework which maintain the progress for the construction process. On the other hand adequate control techniques can be used to maintain the quality of the project according to the required specifications. Hwang, et al (2013).

44. Establishment of monitoring and approval mechanisms for design changes

As mentioned earlier design should satisfy the requirements for the clients and end users. Sometimes these needs changed because of different reasons, or there is lack in the availability of specific techniques. At this time some changes are required to satisfy the current status. These changes should be monitored and approved by authorized personal.

45. Sufficient details on the working drawing documents

One of the most important sets of the contract documents is the working drawing. These drawings are the bases for transforming the conceptual design into built environment. All working drawings should be organized and presented in sufficient way which facilitates dealing with them. Hwang, et al (2013).

46. Establishment of a mechanism for updating the budget.

Budget update means the continual update for the project budget and compares the planned with actual budget using S curve or other techniques. Through this method decision makers can monitor and control the progress of the project and take a decision regarding expenditure, resource usage or other techniques to satisfy the project goals.

47. Establishment of a mechanism for updating the schedule

Schedule update means the continual update for the project schedule and compare between the planned and actual schedule. Through this method decision makers can monitor and control the progress of the project and take a decision regarding to accelerate or slow down the execution of different tasks during the construction process. Hwang, et al (2013).

48. Establishment of a mechanism for reporting progress.

Reports are very important during construction phase it gives the management level image regarding the project situation. Also it considered the source of the information for updating schedule and budget.

49. Initial overuse of CPM/PERT

Critical path method (CPM) "is an algorithm used to define the relation between different activities and define the period for each to end with project schedule, James (1961). Project Evaluation and Review Technique (PERT) is analysis for the time variation for each activity in the critical path to find the shortest, longest and most likely expected time for each of these activities and find the probability of achieving the task with a specific period. These techniques are powerful in planning and managing projects regardless its size. The initial use of these techniques gives clear perception on the project schedule, in addition to manage the resources effectively.

3.4.3. Communication

Effective communication between different participants in the construction projects is strongly required. Hoezen, (2011) stated that Communication can enhance the decision making during the life cycle of the project starting from the initiation of the project up to close project. In addition to its effect on the quality of the work performed. Communication should be managed efficiently to reduce any conflict which may incurred. There are different types of communication in the construction projects depending on the parties involved in the communication. The following are the scenarios for the parties involved in the communication in any construction project.

50. Clear communication channels between the owner/PM and the designer.

51. Clear communication channels between the owner/PM and the contractor.

52. Clear communication channels between the contractor and designer/PM.

53. Clear communication channels between the contractor and the suppliers.

3.4.4. Meetings and Decision making

54. Design control meetings.

Designers as mentioned earlier should satisfy the client's requirements. Different meetings should be held to study the client's needs and test whether the initial sketches satisfy his requirements. These meetings can control the design process and reduce the expected deficiencies in the functional and or technical requirements.

55. Construction control meetings

Because of the difficulty in prepare and planning for all of the construction activities, it is important to control and update the construction process. The construction control meeting during the construction process becomes crucial. During this meeting some project participant should attend this meeting to reduce and resolve any problems appears during the construction. Minutes during this meeting should be

taken and arranged and distribute to the participants after meeting, Hwang et al (2013).

56. Proper priority setting.

When the design and or construction meeting is held participants should discuss and take decisions in different topics. Sometimes there are many alternatives needs to be studied on one issue, or there is contradict between different issues either in the design or during construction. If this accrues these alternatives or contradict issues should be arranged based on their importance to reduce the effort in decision making.

57. Good record of the made decisions.

Decisions which made during any stage in the project life cycle should be recorded in proper manner to eliminate any disputes in the future. Usually these decisions took in different meetings. During these meetings minutes should be taken and distributed over the participants after the meeting end Hwang et al (2013).

3.5. Financial Attributes

58. Bonding capacity of the contractor.

Contractors bonding capacity is the total amount of the contract value that surety can provide the contractor with. www.dictionaryofconstruction.com. Bonding capacity can be used as an indicator for the contractors' credit rating, and the upper amount of money that surety can provide.

59. The contractor's cash flow forecast.

Park, et al (2005) indicated that cash is one of the most important resources for the construction companies. Most of the failures are due to shortage of the liquidity which is required to support different activities. Techniques for the cash flow forecasting are required to reduce any probable failure. Some of these techniques are probabilistic and some others are deterministic. Different models have been developed for this purpose which should be conducted at early stage of the planning phase.

3.6. Management and technical attributes

60. Site organization.

According to the "Health and Safety Executive" website, the organization of the construction site includes a lot of things to be managed such as traffic to assure the ease of the vehicles movement, protecting the public, material storages, waste management, administration, and welfare: providing required facilities in the site such as toilets, water, rooms and others.

61. Construction documents management.

As Bottari (2014) construction documents are the most important part for construction projects. Managing these documents is crucial during all phases of the construction project. For prober management of these documents it should be controlled by specific system of numbering, revision, status, transmittal and documents updating.

62. Usage of IT tools during the project life cycle.

The rapid development of the technology affect all the life aspects by reducing the effort required to perform the work, increase the efficiency, and reduce the time. The usage of IT is important for construction projects; it can be used not only for management purposes it also used for technical aspects during construction.

63. Technical capability of the project participants.

Key personal for consultants, contractors and owners should have the technical capability each in his discipline. Technical capability can reduce conflicts which may incurred during design or construction phase.

64. Knowledge of a particular construction method

According to the self builder website Construction methods are varies depending on the available recourses in the region in addition to their culture. Although this variation in the construction methods there are some methods for the construction become common because of the globalization. The selection of the suitable construction method depends on many criteria such as the associated cost, availability of the required resources in addition to the knowledge of a particular construction method which can affect the success of the project.

65. Establishment of maintenance plans

Planned Preventive Maintenance ('PPM') is an important process which aims to insure that the equipments which related to specific entity are operating well, in addition to prevent any unscheduled breakdown for these equipments. This preventive maintenance carried out periodically by specific agencies.

3.7. Experience and Resource attributes.

3.7.1. Experience and organization attributes.

66. Type of past project completed.

The previous experience of the company in different types of construction projects is crucial since each type of construction project has different requirements, in addition to the unique characteristics and specific requirements for each individual project. Usually construction companies mention their previous executed projects in their portfolio to show their ability in executing different types of projects. This portfolio is useful in the selection procedure for the suitable designers as well as contractors who will execute the work.

67. Size of past project completed.

Many factors can be used to measure the performance of specific construction company. Size of the executed projects can be considered as one of these factors. Size of the executed projects can be measured either by the physical size of the construction or the total cost of the project.

68. Experience of the project participants in the region.

As mentioned earlier, although the globalization in the construction industries around the world, the construction methods still vary depending on the resource availability, this required specific experiences for the project participants in the region where they work. Also this will affect the success of the construction project, especially when we talk about building projects.

69. Size of the company.

One of the indicators which can be used to measure the performance of construction companies is the size of the company. The size of the company can be measured by the capital of the company in addition to the size of the projects in progress.

70. Company' image (reputation).

The reputation of the firm affects the stakeholder decision regarding to their selection criteria. The firms which have a good reputation encourage investors to direct their investment toward them. Also by selecting companies with good reputation stakeholders can reduce the probability of claims which may arise during the construction process. Chun, (2005).

71. Age in business.

The experience of specific firm increased as the number of the executed projects increased, this can be achieved by spending more time in the industry. The experience will increase and this can affect and increase the probability of project success.

72. Litigation tendency.

Dreier (2012) indicated that litigation is process used to achieve goals by lawsuit. In this process there are many goals expected to be achieved such as penalty, damages or verdict. Usually litigation is considered time consumer in construction projects, since it stops the project progress for long time. This affect all parties involved in the process.

3.7.2. Resources attributes.

73. Experience of the technical personal.

Productivity is considered one of the most important factors which affect the project success, since it affect the time and this reflect to the cost, both cost and time are the major components of the resources for the project which have limitation of their availability. The experience of the technical personal here become crucial this is because these personal have a good and known productivity rate inside their efficiency in handling any problem occurs during the construction process.

74. Number of full time employees.

Usually the meaning of full time work is varies between different countries, but usually between 35-45 working hours per week. The total number of the working hours performed by the full time employees per week can reflect the size of the company's productivity.

75. Cultural environment for the employee.

Because of globalization people start travel outside their countries searching for the best job. Host countries usually have different culture than home; this affects the performance of these people. The impact of these people has different characteristics depending on their cultural environment. In this case this impact affects their performance in doing their jobs and on the success of the project.

76. Recruitment and training procedures.

Citehr defined recruitment as procedures which adopted in Enticing, screening and selecting the people who are found qualified to the job. After selecting these people they should be examined to make sure that they have the skills and knowledge which are required to achieve the company's objectives.

77. Adequacy of labor resources and their skills.

Andrew (2005) indicated that there is an evidence effect of the construction skills on the construction industry performance. Crisis on the skilled labor has been notice since it has been found there is an increasing demand on the skilled labor market. For this reason the adequacy and availability of this resource become extremely critical.

78. Adequacy of plant resources.

Resource adequacy (RA) is crucial during planning and procurement stages, to make sure that the available resources are adequate to fulfill their obligation in serving customers according to the schedule. Rules for counting resources should be provided to meet the obligations of the resources adequacy. California ISO shaping renewed future.

3.8. Risk attributes.

3.8.1. Health and environmental attributes.

79. Past health and safety records.

Records for the safety and health issues should be kept in a suitable, accurate and retrieval forms to increase the efficiency of the organization management in addition to its ability to the legal defenses in case of any one sued the organization. It should be known for the organization what type of document should be kept in addition to the required period of the documentation. biggreenbook (2012).

80. Occupational safety and health administration (OSHA) rating.

Occupational Safety and Health Administration (OSHA) is an agency in the department of labor in the united state . this agency concerned with assure that the working conditions for different labors in different situations are safe and healthful. (OSHA)

81. Waste disposal during construction

The impact of the project on the environment is an important factor for the determination of the level of the project success. Different researches indicated that the chosen of the green project can increase the success probability of the construction project. the main components which affect the environment during construction are the excessive materials which most of the times considered as

construction waste. These wastes are consisting of the unwanted materials like insulation, nails rebar, electrical wiring in addition to the damaged and unused materials like wood, concrete and or blocks. National Safety Council

82. Materials and substances used in the project.

This factor deals with the materials which have been used in constructing projects and the composition of these materials. There are different options of materials which can be selected and used in building projects, some of these materials are green materials which have less effect on the environment and some others have extreme effect on the environment. Also by the continuous improvement of the construction industry waste materials which have produced during the construction process can be reduced by producing raw materials from these wastes "cradle to cradle" approach. The selection of the most appropriate material (the optimum selection) is one of the factors which affect the success of the construction project. WBDG Sustainable Committee (2013)

3.8.2. Risk

83. Political risks.

Political risk is defined as the expected loses of the firms' personnel, financial or strategic because of factors out of the market control like social policies (trade, industrial, income and labor) and macroeconomic, or because of instability in the

political conditions like riots, terrorism civil war and coups. These risks can affect the construction industry completely and may leads to failure. Eurasia Group (2006)

84. Economic risks.

Economic risk known as the higher expenditures or the lower income than expectation because of many reasons such as the increase of the raw materials prices, the delay of the new operating facility delivery, production process disturbances, natural disasters, changes in the regime and other reasons which have the power to affect the country economy. Nichols R (2000).

85. Risk identification and allocation.

Each project has unique characteristics due different site conditions and design concept and other factors. This variety in the characteristics of the construction projects found the different types of risks which surrounding the project. these risks affect the achievement of the project goals, and can prohibit meeting cost, time and quality requirements. For these reasons all types of the probable risk should be identified and allocated in order to manage these risks and eliminate or reduce the probability of any obstacles which may affect the construction process. Hwang, et al (2013).

86. Understanding and acceptance of the risk and legal liability by all project participants.

Legally each party involved in the construction process should be responsible for different issues as mentioned in the design and construction contracts. So all project

participants should understand all issues related to each project including all types of the expected risks during the project life cycle. Also they should accept their legal liability about different problems appear during design and construction processes.

87. Force majeure.

Force majeure is a common statement found in contracts; repeal the responsibility from both owner and contractor when an incident out of their control occurs, like war, crime, riot, Or any accident happened by the nature such as flooding, volcano, earthquake and others. These accidents exempt both parties from fulfilling their contractual obligation. If any force majeure occur the contract duration should suspends to the force majeure duration. Schaffer, et al (2011).

88. Latent site conditions.

"Latent conditions" this term is used in the civil projects which have many unseen conditions. So this term arise when the physical condition of the construction site is materially different when compare to what has been expected and described by the contract documents. Bradbury (2010).

3.8.3. Quality attributes

89. Application of total quality management training.

Total quality management can be defined as strategy for managing construction firm aims to increase the efficiency of executing projects, in addition to the firms'

performance to achieve higher reputation in the industry. There are many benefits can be gained by applying total quality managements such as reducing manufacturing costs and the productivity improvement. Ooi, et al (2007).

90. Usage of international quality and safety standards.

There are many standard for the quality control adopted in different industries. ISO 9000 is one of the most common and adopted standards around the world. This standard is used in different industries including engineering and construction. These standards maintain the uniformity over the quality of different types of the projects. And the adoption of these quality standards has the ability to reduce owners' concerns regarding to their projects execution. Bubshait, et al (1999).

91. Implementation of quality control measures.

Quality of any product should be able to be measured using different tool, to assess the level of achieving project objectives. Different types of data should be collected and analyzed during the process to facilitate controlling the project quality. Analyzing these data gives indication regarding how far we are from the stated objectives, UPEDU.

92. Establishment of quality policies in the construction firm.

Hoyle (2005) indicated that quality policy is a long term strategy "10 years" developed by experts and companies' management aims to develop the quality objectives in the firm. Each construction company should develop its own quality policy which gives advantage for the firm comparing to others.

93. Implementation of quality assurance measures.

There are many challenges can be appeared during the execution of the construction projects some of them affect the project duration and others affect the quality of the performed work. To avoid the risk of these obstacles on the project owner, contractors usually should provide quality assurance policy. This assurance system can reduce the cost of the expected failure in addition of its efficiency in maintaining the quality of the services provided by the contractor. Bubshait, et al (1999).

CHAPTER 4

RESEARCH METHODOLOGY

4.1. Introduction

Data regarding criticality of different success factors have been collected from the construction industry to examine the criticality for each success factor from different perceptions. Questionnaire survey and interviews have been found the most efficient tools to collect such data. These tools express the industry perception regarding the data which needed. Figure 4-1 shows the framework adopted to achieve the research objectives.

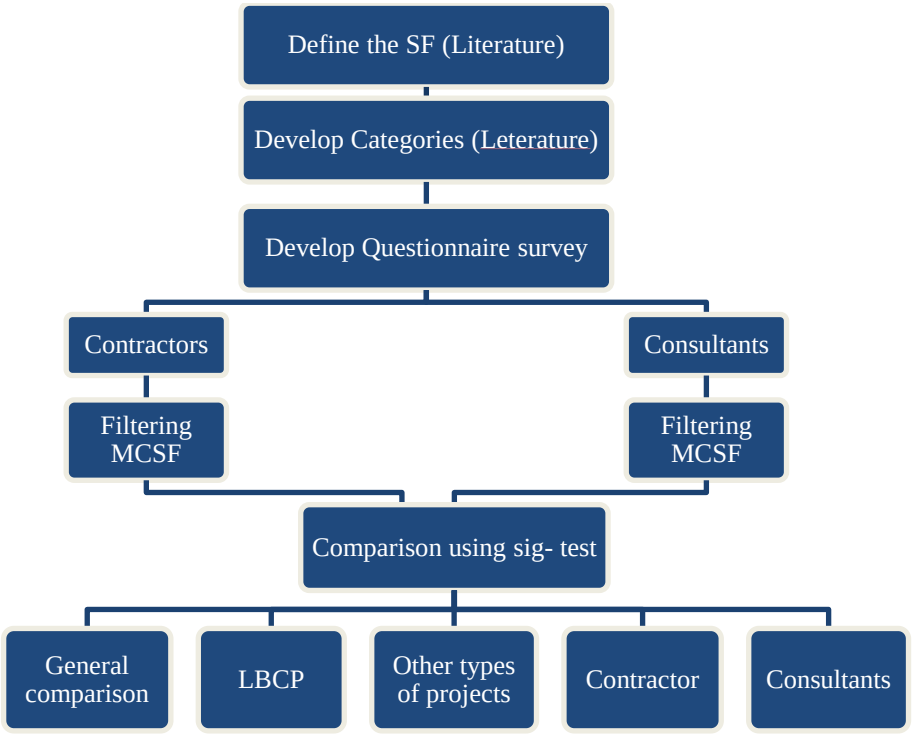


Figure 4- 1 Methodology framework.

4.2. Questionnaire Survey

4.2.1. Development of the survey

The developed questionnaire contains three parts in the first part respondents are asked to answer general questions related to: their working field, classification in case of contractor, project types, also their experience in the construction field in general and in KSA, in addition to their positions. In the second part different factors related to different categories have been identified from the literature review. Only those factors which have consensus between different researchers have been adopted to focus on the factors which have a real effect on the success of the construction projects. On the third part empty table has been provided to give the respondent chance to add any expected missed factor and rank them in addition to add any comments. Appendix A1 shows the questionnaire which has been distributed over consultants and contractors.

4.3. Analyzing questionnaire

4.3.1. Ranking for each success factor

There are different scales which can be used for rating issues or determining level of the respondent agreement among the criticality for each success factor.

Fellows et al (2012) mentioned that 5 or 7 point scales including intermediate value are the most common scales used for ranking. The scale which has been adopted in ranking success factor in this research is the 5 points scale which starts by very little effect on the

project success in point 1 and end with extremely critical on the project success at point 5. Table 4.1 shows the meaning for each value in words and its associated criticality Index.

Table 4. 1 Criticality Index and meaning

Rank	Meaning	Criticality Index
1	Very Little Effect	**20.00 - 40.00%**
2	Little effect	**40.00 - 60.00%**
3	Intermediate effect	**60.00 - 80.00%**
4	High Effect	**80.00 - 90.00%**
5	Extreme Effect	**90.00 - 100%**

From the previous table it has been shown that the criticality index start from 20% not from 0.00. This comes from applying the equation on the minimum expected value for the index which equal N/5N = 20%.

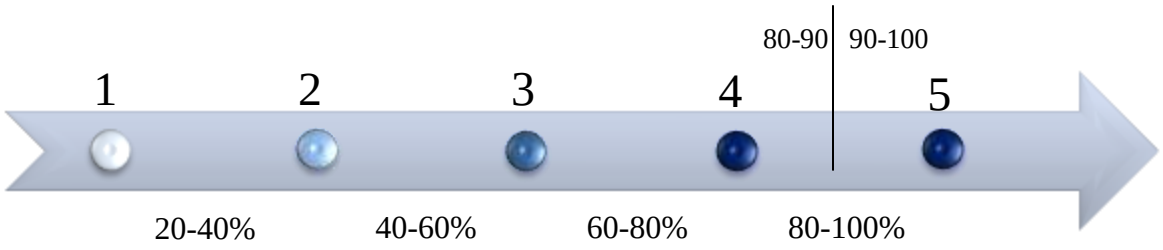


Figure 4- 2 range for the 5 points scale.

The five points scale has been divided into 4 ranges as shown in Figure 4-2. 1-2 get range start from 20% which reflect the answers of 1 and end with 40% which reflect the

answers of 2. 2-3 get range start from 40% which reflect the answers of 2 and end with 60% which reflect the answers of 3. 3-4 get range start from 60% which reflect the answers of 3 and end with 80% which reflect the answers of 4. 4-5 get range start from 80% which reflect the answers of 4 and end with 100% which reflect the answers of 5.

The last 20% (80.00 - 100%) has been divided into the last two groups the high effect and the extreme effect 10% for each.

4.3.2. Factors Filtering

As mentioned earlier this study was covered most of the factors which affect the success of the construction projects. And only those factors which considered as the most critical have been studied deeply. To achieve this objective the criticality index for those factors has been calculated twice. First time from the consultants side, and second time from the contractors side, using the weighted average to find the criticality index for each factor. The following equation gives the criticality index for each factor

$$\text{Criticality Index} = \frac{(1*n1)+(2*n2)+(3*n3)+(4*n4)+(5*n5)}{5*(n1+n2+n3+n4+n5)}$$

Where:

n1, n2, n3, n4, n5: the number of respondents who gave ranks 1, 2, 3, 4, and 5 respectively for each factor.

After calculating the criticality index for each factor only those factors which get rank above 80% (critical and extreme critical) between 4 and 5 point in the ranking scale have been highlighted and selected for further studies.

The results have been shown in tow tables first table reflect the contractors perception and the second table reflect the consultants perception regarding the criticality for the success factors.

4.4. Test statistics

After filtering the comprehensive list of the success factors, significant test has been done to test the difference in perceptions between different groups.

Different hypothesis have been tested by using mann-whitney test which has been found the best tool to be applied in this research. Mann et al, (1947) indicate that this test is more efficient than t-test on the non-parametric distribution for the sample. **SPSS 16**. Software has been used to analyze the data.

The procedures for this test as following:

1- Calculate the **mean rank** and **sum of ranks (R)** for the two populations.

Sum of ranks = $\left(\sum_{a=0}^{b-1} \mathrm{a}+1\right) * \frac{\mathrm{n1}}{\mathrm{N1}} +(\sum_{b}^{c-1} \mathrm{b}+1) * \frac{\mathrm{n2}}{\mathrm{N2}} +(\sum_{c}^{d-1} \mathrm{c}+1) * \frac{\mathrm{n3}}{\mathrm{N3}} + (\sum_{d}^{e-1} \mathrm{d}+1) * \frac{\mathrm{n4}}{\mathrm{N4}}+\ldots\ldots\ldots + (\sum_{e}^{N-1} \mathrm{e}+1) * \frac{\mathrm{n..}}{\mathrm{N..}}$

Where:

a+1: cumulative number from 1 to the number of respondents who gave the factor rank 1for example (1+2+3+4+n1)

the same for b+1, b+3, b+4, etc but for ranks 2, 3, 4, etc.

n1: number of the respondents from population 1 gave the factor rank 1

N1: number of the respondents from the total population gave the factor rank 1

Same for others n2, N2, n3, N3, n4, N4, Etc.

Mean rank1 = sum of ranks1 / Population 1

Mean rank2 = sum of ranks2 / Population 2

2- Calculate the W(Wilcoxon)value which is equal to the $\mathbf{R_{min}}$

W = R (minimum)

3- Calculate U-value for each population **U1** and **U2**

$$\mathbf{U1 = n1 * n2 + n1 * \frac{(n1+1)}{2} - R1}$$

$$\mathbf{U2 = n2 * n1 + n2 * \frac{(n2+1)}{2} - R2}$$

The minimum of the **U1** and **U2** is the value of the **mann- whitney U**

4- Calculate **Z-value**

$$\mathbf{Z= \frac{U-mu}{Stan\ Div}}$$

Where:

Mu = (n1*n2) / 2

$$\mathbf{Stand\ dev = \sqrt[2]{\frac{n1*n2*(n1+n2+1)}{12}}}$$

5- From **Z value** calculate **P-value** which gives the level of significance

6- Take decision regarding **reject or don't reject** the null hypothesis based on the **P-value.**

http://www.statsdirect.com/help/default.htm#nonparametric_methods/mann_whitney.htm%3FTocPath%3DNonparametric%2520methods%7C_____1

4.5. Target group

This study will focus on the consultants and contractors companies working in the Eastern providence in Saudi Arabia. As this research focus on the large construction projects, only contractors and consultants who work on large construction projects have been considered in this study.

According to the *Ministry of Municipal and Rural Affairs* (MOMRA) contractors have been classified into five groups depending on the upper limit of the value for each project they allowed to deal with. Table 4.2 identifies these groups and the upper limit of the projects which have been allowed for them to handle.

Table 4. 2 Classification for Contractors specialized in building projects (MOMRA).

No	**Working Field**	**Class and maximum value for each project they can handle**				
		First	Second	Third	Forth	Fifth
1	Buildings	More than 280	280	70	21	7
2	Transportation	More than 420	420	140	42	14
3	water and sanitation	More than 420	420	140	42	14
4	Electrical works	More than 280	280	70	21	7
5	Electronically works	More than 280	280	70	21	7
6	communication	More than 280	280	70	21	7
7	mechanical works	More than 280	280	70	21	7

This study will focus on the large construction projects, so only contractors who classified in first class have been considered in this study.

4.6. Sample design

Kish (1995) Indicated that there are two aspects for the sample design the first is the process of the sample selection from the population. The second is the estimation process which includes the determination of the sample size from the total population.

In this case the Saudi Consultants and Contractors are considered the population for the study. First the list of this population has been developed and defines those who work in the eastern province in Saudi Arabia. Then the rank for those contractors has been identified to select only the consultants and contractors who deal with large construction projects. By this step the population for the study becomes ready to define the sample size and selection process.

It has been found that the total number of the contractors who classified in the first class in the eastern province and working in the buildings, electrical, mechanical, transportation fields equal to **54 contractors** momra (2014)**.**

Also it has been found that the total number of the consultants who works in the eastern province in KSA equal to **35 consultants** momra (2014).

Defining sample size is important issue which affect the confidence of the results gained from the study many formulas which can be used to calculate the sample size are available. Glenn D (1992) defines different formulas for defining the required sample size for different types of population. The following formula can be used in our case to

define the sample size from consultants and contractors population with 95% confidence level and P (Maximum variability) = 0.5.

$\underline{n = N / (1 + N(e)^2}$ ……. Equation No.1

Where :

n : Required sample size

N: Population size

e : precision level

For contractors the sample size based on 0.05 precision level equal:

$n = 54 / (1 + 54(0.05)^2 = 47$

$n = 47 / (1 + 47(0.05)^2 = 42$

$n = 42 / (1 + 42(0.05)^2 = 38$

$n = 38 / (1 + 38(0.05)^2 = 35$

$n = 35 / (1 + 35(0.05)^2 = 32$

$n = 32 / (1 + 32(0.05)^2 = 30$

$n = 30 / (1 + 30(0.05)^2 = 28$

$n = 28 / (1 + 28(0.05)^2 = 26$

For consultant the sample size based on 0.05 precision level equal:

$n = 35 / (1 + 35(0.05)^2 = 32$

By applying Glenn formula it has been found that the most efficient sample size with 0.05 precision level equal 47 contractors and 32 consultants

4.7. Hypothesis

Many hypothesis have been tested these hypothesis have been shown below.

4.7.1. Differences between consultants and contractors perception regardless project type

Ho : there are no differences between the consultants and the contractor's perception regarding the criticality for the success factors for large construction projects.

Ha : there are differences between the consultants and the contractor's perception regarding the criticality for the success factors for large construction projects.

4.7.2. Differences between the MCSF for LBCP and other types of projects, (contractors' perception).

Ho : there are no differences between the MCSF for LBCP and other types of projects from the contractors' perception).

Ha : there are differences between the MCSF for LBCP and other types of projects from the contractors' perception).

4.7.3. Differences between the MCSF for LBCP and other types of projects, (consultants' perception).

Ho : there are no differences between the MCSF for LBCP and other types of projects from the consultants' perception).

Ha : there are differences between the MCSF for LBCP and other types of projects from the consultants' perception).

4.7.4. Differences between consultants and contractors perception of the critical success factors for LBCP.

Ho: there are no differences between the consultants and the contractor's perception regarding the criticality for the success factors for large building construction projects.

Ha: there are differences between the consultants and the contractor's perception regarding the criticality for the success factors for large building construction projects.

4.7.5. Differences between consultants and contractors perception of the critical success factors for other types of construction projects.

Ho: there are no differences between the consultants and the contractor's perception regarding the criticality for the success factors for large building construction projects.

Ha: there are differences between the consultants and the contractor's perception regarding the criticality for the success factors for large building construction projects.

CHAPTER 5

RESULTS AND ANALYSIS

5.1. Demographical Analysis

5.1.1. Working field for the respondents

Table 5- 1 working field for the respondents.

Working field	No	Percentage
contractors	27	47%
Consultants	34	53%
Total	**61**	**100%**

Table 5-1 demonstrate the distribution for the sample among the working field (consultants and contractors) and it has been shown that the two populations approximately the same 53% consultants and 47% from the contractors side.

5.1.2. Projects Types

Table 5- 2 Project types distribution.

Projects Type	Buildings	Others	Total
Contractors	15	12	27
Consultants	21	13	34
Total	36	25	61
Percentage	59%	41%	100%

Table 5-2 shows the percentage of the respondents who work in building projects vs. those who works in other types of projects such as infrastructure projects and industrial projects. It has been found that 59% of the respondents were working in buildings projects and 41% of them working with other types of projects.

5.1.3. Respondents Experience

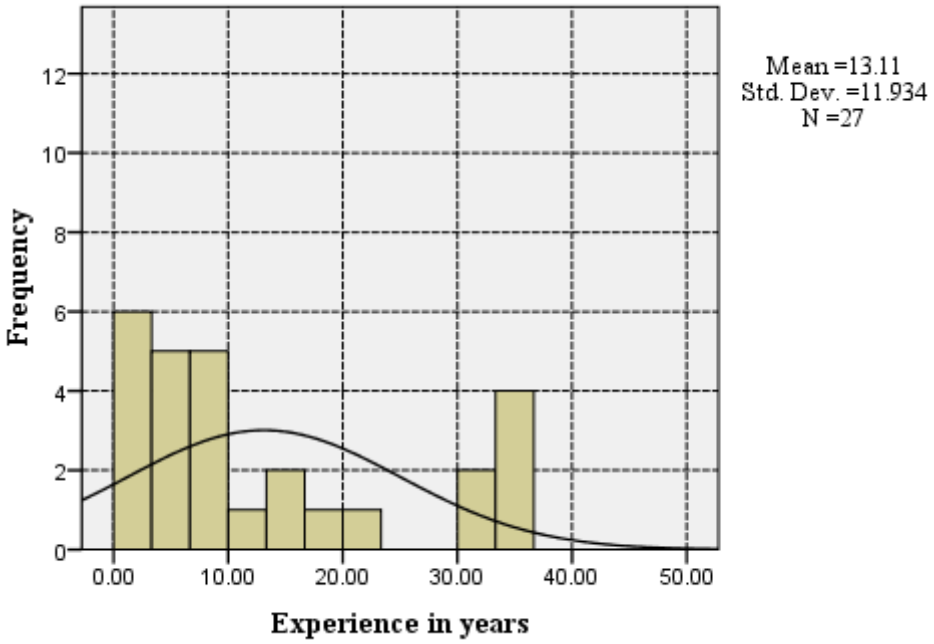


Figure 5- 1 Respondents experience distribution (Contractors).

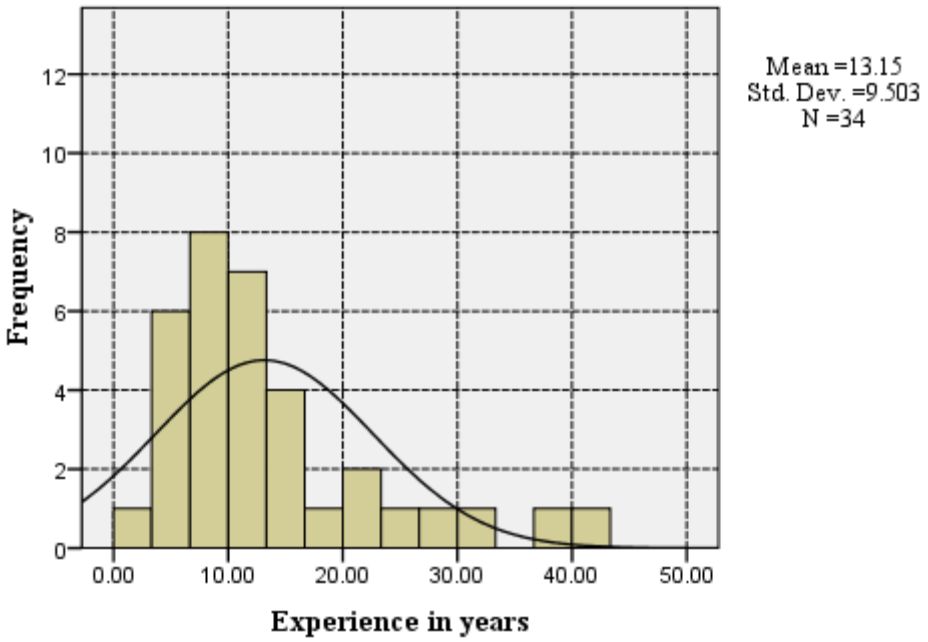


Figure 5- 2 Respondents experience distribution (Consultants).

Figures 5-4 and 5-5 shows the variation of the respondents experience it has been shown that the median of the experience for contractors respondents 11 years. And the median of the experience for consultant's respondents is 13 years.

5.2. Ranking results for the success factors.

5.2.1. Ranking based on the contractors' perception

Table 5- 3 Criticality index for the success factors (contractor's perception)

No	Category	Success Factor	1	2	3	4	5	Score (%)
	Project characteristics							
1		The impact of the project on the public	0	1	5	11	10	**82.22**
2		Technical approval authorities	0	2	8	5	12	**80.00**
3		Adequacy of the allocated funds	0	1	9	10	7	**77.04**
4		Site limitations and location	0	1	9	10	7	**77.04**
5		Use of constructability analysis	0	3	6	10	8	**77.04**
6		Project size	0	2	4	13	8	**80.00**
	Contractual arrangements and administration							
7		Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	0	1	6	11	9	**80.74**
8		Adequacy of plans and specifications	0	4	4	9	10	**78.52**
9		Formal dispute resolution process	0	6	10	8	3	**65.93**
10		Motivation/incentives	2	3	8	11	3	**67.41**
11		Competition strategy	1	2	10	10	4	**70.37**
12		Organizational chart	0	4	10	8	5	**70.37**
13		Comprehensive of the site investigation before tendering	1	3	5	14	4	**72.59**
14		Impartiality in awarding bids to the right designer/contractor	0	0	8	13	6	**78.52**
15		General tolerance to corruption	0	5	7	10	5	**71.11**
16		Little change in client's requirements during construction	1	5	11	8	2	**63.70**
17		Thorough assessment of the contractor's proposal	0	3	11	9	4	**70.37**
	Project Participants							
18		PM competency, authority and involvement	0	0	8	11	8	**80.00**

Table 5- 4 Criticality index for the success factors (contractor's perception). cont.

19	Client	Client experience in dealing with construction projects	0	3	4	13	7	**77.78**
20		Client's understanding of the scope of work before advertising for bids	0	2	6	10	9	**79.26**
21		Capability of the client and his key personnel	0	1	8	8	10	**80.00**
22		Client track record	0	2	8	12	5	**74.81**
23	Contractor	Competency and capability of the contractors' key personnel in different disciplines	0	0	2	14	11	**86.67**
24		The contractor's understanding of the design process	0	0	8	12	7	**79.26**
25		Contractor track record	0	4	8	9	6	**72.59**
26	Designer	The architect's capability for achieving the client's requirements within budget and schedule	0	1	8	12	6	**77.04**
27		Skillful guidance and advice from the architect	0	2	9	12	4	**73.33**
28		Competency and capability of the consultants' key personnel in different disciplines	1	1	12	11	2	**68.89**
29		Consultant track record	0	5	7	14	1	**68.15**
30	Suppliers	Competency and capability of the suppliers' key personnel in different disciplines	1	0	9	11	6	**75.56**
31		Supplier track record	1	5	9	9	3	**65.93**
32	End user	Full understanding of the end users' requirements	0	2	9	10	6	**74.81**
33	Project	Commitment of all project participants to the established schedule and budget	0	1	7	12	7	**78.52**
34	Participants	Good coordination between project participants according to the organizational chart	0	2	5	12	8	**79.26**
35		Development of an agreed upon framework for executing the project	0	1	8	14	4	**75.56**
36		Clarity of the stakeholders roles	0	4	11	9	3	**68.15**
37		Balance of the different stakeholders requirements	0	7	7	13	0	**64.44**
38		Sharing of common project goals among all project participants	0	3	11	11	2	**68.89**
39		Sharing of a clear understanding of functional and technical requirements among all project	0	4	10	7	5	**70.00**
40		Sharing of a high degree of trust between all project participants	0	2	8	13	3	**73.08**
	Interactive processes and communication							
41	Feedback	Monitoring and feedback on the project	0	0	9	14	4	**76.30**
42		knowledge feedback from the contractor to the design team	0	4	13	8	2	**65.93**
43	Control of	Adequacy of the planning and control techniques	0	0	6	13	8	**81.48**
44	Process	Establishment of monitoring and approval mechanisms for design changes	0	2	8	11	6	**75.56**
45		Sufficient details on the working drawing documents	1	1	6	11	8	**77.78**
46		Establishment of a mechanism for updating the budget	0	3	11	9	4	**70.37**
47		Establishment of a mechanism for updating the schedule	0	1	6	17	3	**76.30**

Table 5- 5 Criticality index for the success factors (contractor's perception). Cont.

48		Establishment of a mechanism for reporting progress	2	1	7	12	5	**72.59**
49		Initial overuse of CPM/PERT	0	6	8	11	2	**66.67**
50	Communication	Clear communication channels between the owner/PM and the designer	0	1	7	14	5	**77.04**
51		Clear communication channels between the owner/PM and the contractor	0	1	7	12	7	**78.52**
52		Clear communication channels between the contractor and designer/PM	0	4	4	12	7	**76.30**
53		Clear communication channels between the contractor and the suppliers	0	2	6	10	9	**79.26**
54	Meetings	Design control meetings	2	3	10	10	2	**65.19**
55	And	Construction control meetings	0	2	8	10	7	**76.30**
56	Decision	Proper priority setting	1	2	8	10	6	**73.33**
57	Making	Good record of the made decisions	0	5	4	13	5	**73.33**
	Financial Attributes							
58		Bonding capacity of the contractor	1	0	8	12	6	**76.30**
59		The contractor's cash flow forecast	0	0	5	15	7	**81.48**
	Management and technical attributes							
60		Site organization	0	1	12	11	3	**71.85**
61		Construction documents management	0	0	6	15	6	**80.00**
62		Usage of IT tools during the project life cycle	1	2	4	15	5	**75.56**
63		Technical capability of the project participants	1	3	8	12	3	**69.63**
64		Knowledge of a particular construction method	0	5	5	11	6	**73.33**
65		Establishment of maintenance plans	1	4	7	14	1	**67.41**
	Experience and Resource attributes							
66		Type of past project completed	0	1	10	15	1	**71.85**
67	Experience	Size of past project completed	0	2	12	13	0	**68.15**
68	And	Experience of the project participants in the region	0	3	10	9	5	**71.85**
69	Organization	Size of the company	1	2	3	18	3	**74.81**
70	Attributes	Company image (reputation)	1	1	9	13	3	**71.85**
71		Age in business	1	2	6	13	5	**74.07**
72		Litigation tendency	2	6	6	9	4	**65.19**
73		Experience of the technical personal	0	0	8	10	9	**80.74**
74	Resources	Number of full time employees	2	3	5	14	3	**69.63**

Table 5- 6 Criticality index for the success factors (contractor's perception). cont.

75	Attributes	Cultural environment for the employee	2	4	10	6	5	**65.93**
76		Recruitment and training procedures	2	2	8	14	1	**67.41**
77		Adequacy of labor resources and their skills	0	2	3	11	11	**82.96**
78		Adequacy of plant resources	0	2	10	11	4	**72.59**
	Risk attributes							
79	Health and	Past health and safety records	1	4	5	13	4	**71.11**
80	Environmental	Occupational safety and health administration (OSHA) rating	1	6	7	11	2	**65.19**
81	Attributes	Waste disposal during construction	2	3	10	5	7	**68.89**
82		Materials and substances used in the project	2	2	8	12	3	**68.89**
83	Risk	Political risks	4	6	5	9	3	**60.74**
84		Economic risks	0	0	9	12	6	**77.78**
85		Risk identification and allocation	1	2	9	10	5	**71.85**
86		Understanding and acceptance of the risk and legal liability by all project participants	0	2	8	13	4	**74.07**
87		Force majeure	3	6	4	6	8	**67.41**
88		Latent site conditions	0	4	10	12	1	**67.41**
89		Application of total quality management training	0	4	5	16	2	**71.85**
90		Usage of international quality and safety standards	0	7	3	14	3	**69.63**
91	Quality	Implementation of quality control measures	0	4	2	14	7	**77.78**
92	Attributes	Establishment of quality policies in the construction firm	0	3	6	13	5	**74.81**
93		Implementation of quality assurance measures	0	2	6	10	9	**79.26**

Table 5-5 shows the variation of the criticality scores for the success factors form the contractors' point of view which varies between **60.74%** and **86.67%.** As mentioned before, only those factors which have score above 80.00% based on the criticality scale have been selected for further analysis.

5.2.2. Ranking based on the contractors' perception (The most critical)

From the contractors perception 12 out of the 93 factors have been selected for further analysis based on their criticality. The scores for these factors vary between **80.00%** and **86.67%** those factors are belonged to different categories as following:

F1, F2, and F6 Project characteristics. **F7** Contractual arrangements and administration. **F18**, **F21 and F23,** Project Participants. **F43,** Interactive processes and communication. **F59** Financial Attributes. **F61** Management and technical attributes. **F73**, **F77** Experience and Resource attributes. And there is no criticality for the last category which is the risk attributes on the project success. The following table is showing the score for each of these critical factors starting from the highest score.

Table 5- 7 the most critical factors (Contractors perception).

No	Success Factor	Score (%)
23	Competency & capability of the contractors' key personnel in different disciplines	**86.67**
77	Adequacy of labor resources and their skills	**82.96**
1	The impact of the project on the public	**82.22**
43	Adequacy of the planning and control techniques	**81.48**
59	The contractor's cash flow forecast	**81.48**
7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	**80.74**
73	Experience of the technical personal	**80.74**
2	Technical approval authorities	**80.00**
6	Project size	**80.00**
18	PM competency, authority and involvement	**80.00**
21	Capability of the client and his key personnel	**80.00**
61	Construction documents management	**80.00**

5.2.3. Ranking based on the consultants perception

Table 5- 8 Criticality index for the success factors (consultants' perception).

No	Category	Success Factor	1	2	3	4	5	Score (%)
	Project characteristics							
1		The impact of the project on the public	3	7	8	9	7	**65.88**
2		Technical approval authorities	0	3	8	12	11	**78.24**
3		Adequacy of the allocated funds	2	2	9	12	9	**74.12**
4		Site limitations and location	0	3	11	14	6	**73.53**
5		Use of constructability analysis	0	1	7	18	8	**79.41**
6		Project size	0	3	16	9	6	**70.59**
	Contractual arrangements and administration							
7		Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	0	2	10	15	6	**75.15**
8		Adequacy of plans and specifications	0	1	7	20	6	**78.24**
9		Formal dispute resolution process	0	5	16	8	5	**67.65**
10		Motivation/incentives	2	1	15	11	5	**69.41**
11		Competition strategy	0	5	14	10	5	**68.82**
12		Organizational chart	0	6	12	12	4	**68.24**
13		Comprehensive of the site investigation before tendering	0	3	12	12	7	**73.53**
14		Impartiality in awarding bids to the right designer/contractor	0	4	6	12	12	**78.82**
15		General tolerance to corruption	1	4	13	7	9	**71.18**
16		Little change in client's requirements during construction	3	3	12	13	3	**65.88**
17		Thorough assessment of the contractor's proposal	0	3	16	11	4	**69.41**
	Project Participants							
18	Project Manager	PM competency, authority and involvement	0	0	9	7	18	**85.29**
19	Client	Client experience in dealing with construction projects	1	1	12	12	8	**74.71**
20		Client's understanding of the scope of work before advertising for bids	0	1	9	15	9	**78.82**
21		Capability of the client and his key personnel	0	0	14	15	5	**74.71**

Table 5- 9 Criticality index for the success factors (consultants' perception). Cont.

22		Client track record	0	3	15	7	9	**72.94**
23	Contractor	Competency and capability of the contractors' key personnel in different disciplines	0	1	7	12	14	**82.94**
24		The contractor's understanding of the design process	0	2	7	15	10	**79.41**
25		Contractor track record	0	2	5	19	8	**79.41**
26	Designer	The architect's capability for achieving the client's requirements within budget and schedule	0	2	8	13	11	**79.41**
27		Skillful guidance and advice from the architect	0	2	11	12	9	**76.47**
28		Competency and capability of the consultants' key personnel in different disciplines	0	0	3	17	14	**86.47**
29		Consultant track record	0	1	4	16	13	**84.12**
30	Suppliers	Competency and capability of the suppliers' key personnel in different disciplines	0	0	8	21	5	**78.24**
31		Supplier track record	0	0	10	20	4	**76.47**
32	End user	Full understanding of the end users' requirements	0	5	6	13	10	**76.47**
33	Project	Commitment of all project participants to the established schedule and budget	0	1	9	9	15	**82.35**
34	Participants	Good coordination between project participants according to the organizational chart	0	0	10	12	12	**81.18**
35		Development of an agreed upon framework for executing the project	0	0	16	17	1	**71.18**
36		Clarity of the stakeholders roles	0	0	16	16	2	**71.76**
37		Balance of the different stakeholders requirements	0	2	20	10	2	**67.06**
38		Sharing of common project goals among all project participants	0	3	13	12	6	**72.35**
39		Sharing of a clear understanding of functional and technical requirements among all project	0	3	15	12	4	**70.00**
40		Sharing of a high degree of trust between all project participants	0	3	11	14	6	**73.53**
	Interactive processes and communication							
41	Feedback	Monitoring and feedback on the project	0	1	7	19	7	**78.82**
42		knowledge feedback from the contractor to the design team	1	1	11	14	7	**74.71**
43	Control of	Adequacy of the planning and control techniques	0	1	10	15	8	**77.65**
44	Process	Establishment of monitoring and approval mechanisms for design changes	0	2	9	17	6	**75.88**
45		Sufficient details on the working drawing documents	0	3	8	14	9	**77.06**
46		Establishment of a mechanism for updating the budget	0	2	17	11	4	**70.00**
47		Establishment of a mechanism for updating the schedule	0	2	16	10	6	**71.76**
48		Establishment of a mechanism for reporting progress	0	1	14	13	6	**74.12**
49		Initial overuse of CPM/PERT	0	2	16	13	3	**70.00**
50	Communication	Clear communication channels between the owner/PM and the designer	0	0	1	22	11	**85.88**

Table 5- 10 Criticality index for the success factors (consultants' perception). Cont.

51		Clear communication channels between the owner/PM and the contractor	0	0	5	20	9	**82.35**
52		Clear communication channels between the contractor and designer/PM	0	0	6	18	10	**82.35**
53		Clear communication channels between the contractor and the suppliers	0	0	8	17	9	**80.59**
54	Meetings	Design control meetings	0	1	9	19	5	**76.47**
55	And	Construction control meetings	0	0	7	21	6	**79.41**
56	Decision	Proper priority setting	0	1	12	14	7	**75.88**
57	Making	Good record of the made decisions	0	1	10	14	9	**78.24**
	Financial Attributes							
58		Bonding capacity of the contractor	1	3	15	11	4	**68.24**
59		The contractor's cash flow forecast	0	5	7	14	8	**74.71**
	Management and technical attributes							
60		Site organization	0	0	13	13	8	**77.06**
61		Construction documents management	0	1	8	17	8	**78.82**
62		Usage of IT tools during the project life cycle	1	3	11	15	4	**70.59**
63		Technical capability of the project participants	0	1	14	16	3	**72.35**
64		Knowledge of a particular construction method	0	4	8	17	5	**73.53**
65		Establishment of maintenance plans	1	3	13	16	1	**67.65**
	Experience and Resource attributes							
66		Type of past project completed	1	3	11	15	4	**70.59**
67	Experience	Size of past project completed	0	6	12	12	4	**68.24**
68	And	Experience of the project participants in the region	0	3	13	13	5	**71.76**
69	Organization	Size of the company	1	5	14	10	4	**66.47**
70	Attributes	Company image (reputation)	1	3	12	12	6	**71.18**
71		Age in business	1	3	16	12	2	**66.47**
72		Litigation tendency	0	6	13	13	2	**66.47**
73		Experience of the technical personal	0	2	9	15	8	**77.06**
74	Resources	Number of full time employees	0	6	14	8	6	**68.24**
75	Attributes	Cultural environment for the employee	0	5	15	11	3	**67.06**
76		Recruitment and training procedures	0	7	13	9	5	**67.06**
77		Adequacy of labor resources and their skills	0	3	9	17	5	**74.12**

Table 5- 11 Criticality index for the success factors (consultants' perception). Cont.

78		Adequacy of plant resources	0	3	12	13	6	**72.94**
	Risk attributes							
79	Health and	Past health and safety records	0	6	12	13	3	**67.65**
80	Environmental	Occupational safety and health administration (OSHA) rating	1	1	16	11	5	**70.59**
81	Attributes	Waste disposal during construction	0	6	10	11	7	**71.18**
82		Materials and substances used in the project	0	4	12	13	5	**71.18**
83	Risk	Political risks	1	10	12	6	5	**62.35**
84		Economic risks	1	2	16	12	3	**68.24**
85		Risk identification and allocation	1	4	17	9	3	**65.29**
86		Understanding and acceptance of the risk and legal liability by all project participants	0	4	14	12	4	**69.41**
87		Force majeure	1	9	16	5	3	**60.00**
88		Latent site conditions	0	9	14	9	2	**62.35**
89		Application of total quality management training	0	2	17	11	4	**70.00**
90		Usage of international quality and safety standards	0	2	13	13	6	**73.53**
91	Quality	Implementation of quality control measures	0	2	12	16	4	**72.94**
92	Attributes	Establishment of quality policies in the construction firm	0	4	11	15	4	**71.18**
93		Implementation of quality assurance measures	0	1	9	16	8	**78.24**

Table 5-7 shows the variation of the criticality scores for the success factors form the consultants' point of view which varies between 60.00% and 86.47%. As mentioned before, only those factors which have score above 80.00% based on the criticality scale have been selected for further analysis.

5.2.4. Ranking based on the consultants' perception (The most critical)

From the consultants perception 10 out of the 93 factors have been selected for further analysis based on their criticality. The scores for these factors vary between 80.59% and 86.47% these factors are belonged only to two categories which are Project Participants and Interactive processes and communication. Where **F18, F23, F28, F29, F33,** and **F34** are belonged to the project participants, and **F50, F51, F52** and **F53** are belonged to the Interactive processes and communication.

Table 5- 12 the most critical factors (Consultants' perception)

No	Success Factor	Score (%)
28	Competency and capability of the consultants' key personnel in different disciplines	**86.47**
50	Clear communication channels between the owner/PM and the designer	**85.88**
18	PM competency, authority and involvement	**85.29**
29	Consultant track record	**84.12**
23	Competency and capability of the contractors' key personnel in different disciplines	**82.94**
33	Commitment of all project participants to the established schedule and budget	**82.35**
51	Clear communication channels between the owner/PM and the contractor	**82.35**
52	Clear communication channels between the contractor and designer/PM	**82.35**
34	Good coordination between project participants according to the organizational chart	**81.18**
53	Clear communication channels between the contractor and the suppliers	**80.59**

5.2.5. The most critical success factors list

Table 5- 13 Comparison list between the most critical success factors from the consultants' and or contractors' perspective.

No	Factor	Contractor Criticality Index	Consultant Criticality Index	Overall Score
23	Competency and capability of the contractors' key personnel in different disciplines	**86.67**	**82.94**	84.80
18	PM competency, authority and involvement	**80.00**	**85.29**	82.65
50	Clear communication channels between the owner/PM and the designer	**77.04**	**85.88**	81.46
33	Commitment of all project participants to the established schedule and budget	**78.52**	**82.35**	80.44
51	Clear communication channels between the owner/PM and the contractor	**78.52**	**82.35**	80.44
34	Good coordination between project participants according to the organizational chart	**79.26**	**81.18**	80.22
53	Clear communication channels between the contractor and the suppliers	**79.26**	**80.59**	79.92
43	Adequacy of the planning and control techniques	**81.48**	**77.65**	79.56
61	Construction documents management	**80.00**	**78.82**	79.41
52	Clear communication channels between the contractor and designer/PM	**76.30**	**82.35**	79.32
2	Technical approval authorities	**80.00**	**78.24**	79.12
73	Experience of the technical personal	**80.74**	**77.06**	78.90
77	Adequacy of labor resources and their skills	**82.96**	**74.12**	78.54
59	The contractor's cash flow forecast	**81.48**	**74.71**	78.09
7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	**80.74**	**75.15**	77.95
28	Competency and capability of the consultants' key personnel in different disciplines	**68.89**	**86.47**	77.68
21	Capability of the client and his key personnel	**80.00**	**74.71**	77.35
29	Consultant track record	**68.15**	**84.12**	76.13
6	Project size	**80.00**	**70.59**	75.29
1	The impact of the project on the public	**82.22**	**65.88**	74.05

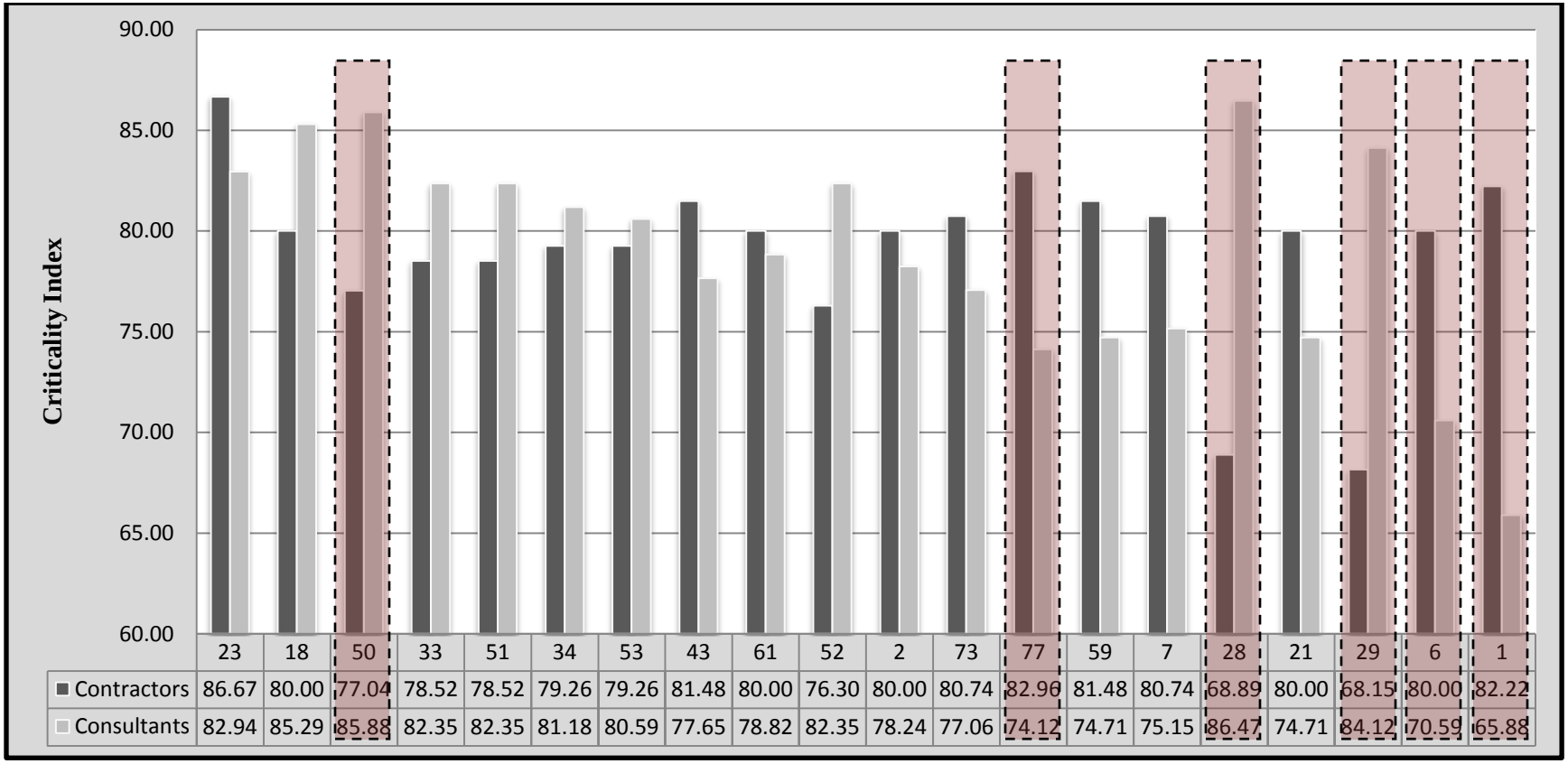


Figure 5- 3 Comparison between the criticality index for contractors and consultants.

Figure 5-5 is graphical representation for the Table 5-9 which includes all critical factors from either contractors' or consultants' perspective or both. From Figure 5-5 it has been found that there is an expected significant difference in perception between contractors' and consultant' regarding the factors, (**F50:** Clear communication channels between the owner/PM and the designer), (**F77:** Adequacy of labor resources and their skills)**,** (**F28:** Competency and capability of the consultants' key personnel in different disciplines)**,** (**F29:** Consultant track record)**,** (**F6:** Project size) and (**F1** The impact of the project on the public). Where there is consensus over the other factors between contractors' and consultants'. Further analyses have been conducted to prove this expectation.

5.3. Correlation test

Over all agreement between consultants and contractors among the success factors have been tested using Pearson correlation. This test can provide evidence regarding the consensus over the criticality for the success factors between different participant in the survey (consultants and contractors). Tables 5-9, 5-10, and 5-11. Shows the correlation results.

Table 5- 14 Paired Samples Statistics.

		Mean	**N**	**Std. Deviation**	**Std Error mean**
Pair 1	Contractors	73.91473	93	5.2256	0.54187
	Consultants	73.54086	93	5.5622	0.57677

Table 5- 15 Paired Samples Correlations.

		N	Correlation	Sig.
Pair 1	Contractors & Consultants	93	**0.597**	0.000

Table 5- 16 Paired Samples Test.

		Paired Differences							
					95% confidence interval of the difference				
		Mean	Std deviation	Std Error mean	Lower	Upper	t	df	Sig (2-tailed)
Pair 1	Contractors Consultants	0.374	4.852	0.503	-0.625	1.373	0.743	92	**0.459**

From Table 5-10 it has been found that the correlation results equal to 0.597 (positive correlation), another test has been conducted to test whether this value should be rejected or not, the result shows that P-value equal 0.459. This means that if the correlation result below this value the perception of the two populations is different. **0.597 >0.459** this means that there is no difference between the contractors' and the consultants' perception on the criticality for the success factors in general.

5.4. Test statistics for the MCSF general list.

A correlation result shows that there is no difference between the consultants' and contractors' perception on the criticality for the 93 factors list in general. After the development of the list for the most critical success factors from the consultants and or contractors perceptions it is important to check each of the MCSF whether there is a difference between their perceptions or not. Table 5-9 shows the mean rank and sum of ranks for each factor from contractors' and consultants' perception depending on the questionnaire results. These results were used in the **Mann-Whitney Test.**

Table 5- 17 mean rank and sum of ranks for the most critical success factors (contractors and consultants perspectives).

No	Factor	Working field	N	Mean Rank	Sum of Ranks
F1	The impact of the project on the public	Contractors	27	36.70	991
		Consultants	34	26.47	900
		Total	61		
F2	Technical approval authorities	Contractors	27	31.20	842.5
		Consultants	34	30.84	1048.5
		Total	61		
F6	Project size	Contractors	27	35.50	958.5
		Consultants	34	27.43	932.5
		Total	61		
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	Contractors	27	33.81	913
		Consultants	34	28.76	978
		Total	61		
F18	PM competency, authority and involvement	Contractors	27	27.37	739
		Consultants	34	33.88	1152
		Total	61		
F21	Capability of the client and his key personnel	Contractors	27	33.31	899.5
		Consultants	34	29.16	991.5
		Total	61		
F23	Competency and capability of the contractors' key personnel in different disciplines	Contractors	27	32.09	866.5
		Consultants	34	30.13	1024.5
		Total	61		
F28	Competency and capability of the consultants'	Contractors	27	21.30	575
		Consultants	34	38.71	1316

	key personnel in different disciplines	Total	61		
F29	Consultant track record	Contractors	27	22.17	598.5
		Consultants	34	38.01	1292.5
		Total	61		
F33	Commitment of all project participants to the established schedule and budget	Contractors	27	28.24	762.5
		Consultants	34	33.19	1128.5
		Total	61		
F34	Good coordination between project participants according to the organizational chart	Contractors	27	29.48	796
		Consultants	34	32.21	1095
		Total	61		
F43	Adequacy of the planning and control techniques	Contractors	27	32.24	870.5
		Consultants	34	30.01	1020.5
		Total	61		
F50	Clear communication channels between the owner/PM and the designer	Contractors	27	25.61	691.5
		Consultants	34	35.28	1199.5
		Total	61		
F51	Clear communication channels between the owner/PM and the contractor	Contractors	27	28.41	767
		Consultants	34	33.06	1124
		Total	61		
F52	Clear communication channels between the contractor and designer/PM	Contractors	27	28.52	770
		Consultants	34	32.97	1121
		Total	61		
F53	Clear communication channels between the contractor and the suppliers	Contractors	27	30.22	816
		Consultants	34	31.62	1075
		Total	61		
F59	The contractor's cash flow forecast	Contractors	27	33.30	899
		Consultants	34	29.18	992
		Total	61		
F61	Construction documents management	Contractors	27	30.87	833.5
		Consultants	34	31.10	1057.5
		Total	61		
F73	Experience of the technical personal	Contractors	27	31.91	861.5
		Consultants	34	30.28	1029.5
		Total	61		
F77	Adequacy of labor resources and their skills	Contractors	27	35.85	968
		Consultants	34	27.15	923
		Total	61		

Table 5- 18 significance test for the difference in perception between contractors and consultants.

Factor No	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Monte Carlo Sig. (2-tailed)		
					95% Confidence Interval		
					Sig.	Lower Bound	Upper Bound
F1	305	900	-2.312	**0.021**	0.020	0.018	0.023
F2	453.5	1048.5	-0.084	**0.933**	0.946	0.942	0.951
F6	337.5	932.5	-1.857	**0.063**	0.064	0.059	0.069
F7	383	978	-1.174	**0.240**	0.248	0.240	0.257
F18	361	739	-1.517	**0.129**	0.129	0.122	0.135
F21	396.5	991.5	-0.961	**0.336**	0.333	0.324	0.342
F23	429.5	1024.5	-0.462	**0.644**	0.663	0.654	0.673
F28	197	575	-4.071	**0.000**	0.000	0.000	0.000
F29	220.5	598.5	-3.706	**0.000**	0.000	0.000	0.000
F33	384.5	762.5	-1.140	**0.254**	0.256	0.247	0.264
F34	418	796	-0.631	**0.528**	0.534	0.524	0.544
F43	425.5	1020.5	-0.522	**0.601**	0.607	0.597	0.616
F50	313.5	691.5	-2.400	**0.016**	0.016	0.014	0.018
F51	389	767	-1.107	**0.268**	0.288	0.279	0.297
F52	392	770	-1.051	**0.293**	0.300	0.291	0.309
F53	438	816	-0.324	**0.746**	0.752	0.743	0.760
F59	397	992	-0.960	**0.337**	0.346	0.337	0.356
F61	455.5	833.5	-0.055	**0.956**	1.000	1.000	1.000
F73	434.5	1029.5	-0.378	**0.706**	0.747	0.738	0.756
F77	328	923	-2.029	**0.042**	0.039	0.035	0.042

Table 5-13 shows the Mann-Whitney U test results including the significance results which help in taking decision regarding to the hypotheses (reject or not). The significance test has been simulated 10000 times using **Monte Carlo simulation** to get the lower and upper bond for the significance value. From the results which have been shown in Table 5-13 we can conclude that the null hypothesis which says that there is no difference between consultants' and contractors' perception regarding to the criticality for the MCSFs has been rejected for the factors **F1** (The impact of the project on the public)**, F28**

(Competency and capability of the consultants' key personnel in different disciplines), **F29** (Consultant track record)**, F50** (Clear communication channels between the owner/PM and the designer) **and F77** (Adequacy of labor resources and their skills)**,** this is because they got P-value equal to **0.021, 0.000, 0.000, 0.016, and 0.042**, respectively which are less than 0.05 in the 95% confidence level. This means that these differences in the perceptions results didn't come by chance.

For example by showing the results for F50, (*Clear communication channels between the owner/PM and the designer).* From the consultants perception this factor has been considered as one of the most critical factors and get a score 85.88% which considered (critical) but from the other perception this factor got **77.04** (intermediate criticality). U-test has been given a conclusion that there is significant difference in the perception in more than 95% of the cases.

5.5. Test statistics and comparison between the LBCP and others

5.5.1. Contractors' perception.

The hypothesis which has been tested is. There is no difference between the critical success factors for large building construction projects (LBCP) and other types of projects from the contractors' perception. Table 5-14 shows the results for the mean rank and some of ranks for both contractors who work in LBCP and other types of projects.

Table 5- 19 Comparison between Building projects and other types contractors' perception.

No	Factor	Project type	N	Mean Rank	Sum of Ranks
F1	The impact of the project on the public	Buildings	15	15.67	235
		Other types	12	11.92	143
		Total	27		
F2	Technical approval authorities	Buildings	15	15.03	225.5
		Other types	12	12.71	152.5
		Total	27		
F6	Project size	Buildings	15	15.97	239.5
		Other types	12	11.54	138.5
		Total	27		
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	Buildings	15	13.47	202
		Other types	12	14.67	176
		Total	27		
F18	PM competency, authority and involvement	Buildings	15	13.30	199.5
		Other types	12	14.88	178.5
		Total	27		
F21	Capability of the client and his key personnel	Buildings	15	11.93	179
		Other types	12	16.58	199
		Total	27		
F23	Competency and capability of the contractors' key personnel in different disciplines	Buildings	15	15.40	231
		Other types	12	12.25	147
		Total	27		
F28	Competency and capability of the consultants' key personnel in different disciplines	Buildings	15	12.60	189
		Other types	12	15.75	189
		Total	27		
F29	Consultant track record	Buildings	15	12.73	191
		Other types	12	15.58	187
		Total	27		

F33	Commitment of all project participants to the established schedule and budget	Buildings	15	12.90	193.5
		Other types	12	15.38	184.5
		Total	27		
F34	Good coordination between project participants according to the organizational chart	Buildings	15	14.37	215.5
		Other types	12	13.54	162.5
		Total	27		
F43	Adequacy of the planning and control techniques	Buildings	15	13.33	200
		Other types	12	14.83	178
		Total	27		
F50	Clear communication channels between the owner/PM and the designer	Buildings	15	14.47	217
		Other types	12	13.42	161
		Total	27		
F51	Clear communication channels between the owner/PM and the contractor	Buildings	15	14.40	216
		Other types	12	13.50	162
		Total	27		
F52	Clear communication channels between the contractor and designer/PM	Buildings	15	13.83	207.5
		Other types	12	14.21	170.5
		Total	27		
F53	Clear communication channels between the contractor and the suppliers	Buildings	15	14.20	213
		Other types	12	13.75	165
		Total	27		
F59	The contractor's cash flow forecast	Buildings	15	13.77	206.5
		Other types	12	14.29	171.5
		Total	27		
F61	Construction documents management	Buildings	15	15.17	227.5
		Other types	12	12.54	150.5
		Total	27		
F73	Experience of the technical personal	Buildings	15	14.30	214.5
		Other types	12	13.63	163.5
		Total	27		
F77	Adequacy of labor resources and their skills	Buildings	15	12.37	185.5
		Other types	12	16.04	192.5
		Total	27		

Table 5- 20 significance test for the difference between success factors for LBCP and others (contractors' perception).

Factor No	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Monte Carlo Sig. (2-tailed)		
					95% Confidence Interval		
					Sig.	Lower Bound	Upper Bound
F1	65.0	143.0	-1.291	**0.197**	0.200	0.192	0.208
F2	74.5	152.5	-0.802	**0.423**	0.438	0.428	0.447
F6	60.5	138.5	-1.547	**0.122**	0.138	0.131	0.145
F7	82.0	202.0	-0.414	**0.679**	0.730	0.721	0.738
F18	79.5	199.5	-0.541	**0.589**	0.630	0.620	0.639
F21	59.0	179.0	-1.589	**0.112**	0.115	0.108	0.121
F23	69.0	147.0	-1.131	**0.258**	0.268	0.259	0.276
F28	69.0	189.0	-1.102	**0.271**	0.286	0.277	0.294
F29	71.0	191.0	-0.999	**0.318**	0.324	0.315	0.333
F33	73.5	193.5	-0.849	**0.396**	0.423	0.414	0.433
F34	84.5	162.5	-0.285	**0.775**	0.806	0.798	0.814
F43	80.0	200.0	-0.528	**0.598**	0.789	0.780	0.797
F50	83.0	161.0	-0.372	**0.710**	0.732	0.723	0.741
F51	84.0	162.0	-0.309	**0.757**	0.816	0.808	0.823
F52	87.5	207.5	-0.129	**0.897**	0.938	0.933	0.942
F53	87.0	165.0	-0.153	**0.878**	0.903	0.897	0.909
F59	86.5	206.5	-0.187	**0.852**	0.923	0.918	0.928
F61	72.5	150.5	-0.932	**0.351**	0.356	0.346	0.365
F73	85.5	163.5	-0.233	**0.816**	0.875	0.869	0.882
F77	65.5	185.5	-1.285	**0.199**	.210b	0.202	0.218

All P-values for all factors are above 0.05 which means that at 95% confidence level it has been found that there is no significance different between the critical success factors for LBCP and other types of projects from the contractors' perception.

5.5.2. Consultants' perception.

The hypothesis which has been tested is. There is no difference between the critical success factors for large building construction projects (LBCP) and other types of projects from the consultants' perception. Table 5-16 shows the results for the mean rank and some of ranks for both consultants who work in LBCP and other types of projects.

Table 5- 21 Comparison between Building projects and other types from consultants' perception.

No	Factor	Project type	N	Mean Rank	Sum of Ranks
F1	The impact of the project on the public	Buildings	21	17.86	375
		Other types	13	16.92	220
		Total	34		
F2	Technical approval authorities	Buildings	21	18.43	387
		Other types	13	16.00	208
		Total	34		
F6	Project size	Buildings	21	16.07	337.5
		Other types	13	19.81	257.5
		Total	34		
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	Buildings	21	17.98	377.5
		Other types	13	16.73	217.5
		Total	34		
F18	PM competency, authority and involvement	Buildings	21	17.64	370.5
		Other types	13	17.27	224.5
		Total	34		
F21	Capability of the client and his key personnel	Buildings	21	16.05	337
		Other types	13	19.85	258
		Total	34		
F23	Competency and capability of the contractors' key personnel in different disciplines	Buildings	21	17.17	360.5
		Other types	13	18.04	234.5
		Total	34		
F28	Competency and capability of the consultants' key personnel in different disciplines	Buildings	21	18.90	397
		Other types	13	15.23	198
		Total	34		
F29	Consultant track record	Buildings	21	18.07	379.5
		Other types	13	16.58	215.5
		Total	34		
F33	Commitment of all project participants to the established schedule and budget	Buildings	21	18.57	390
		Other types	13	15.77	205
		Total	34		

F34	Good coordination between project participants according to the organizational chart	Buildings	21	17.36	364.5
		Other types	13	17.73	230.5
		Total	34		
F43	Adequacy of the planning and control techniques	Buildings	21	18.17	381.5
		Other types	13	16.42	213.5
		Total	34		
F50	Clear communication channels between the owner/PM and the designer	Buildings	21	17.45	366.5
		Other types	13	17.58	228.5
		Total	34		
F51	Clear communication channels between the owner/PM and the contractor	Buildings	21	17.17	360.5
		Other types	13	18.04	234.5
		Total	34		
F52	Clear communication channels between the contractor and designer/PM	Buildings	21	15.98	335.5
		Other types	13	19.96	259.5
		Total	34		
F53	Clear communication channels between the contractor and the suppliers	Buildings	21	17.12	359.5
		Other types	13	18.12	235.5
		Total	34		
F59	The contractor's cash flow forecast	Buildings	21	18.76	394
		Other types	13	15.46	201
		Total	34		
F61	Construction documents management	Buildings	21	16.60	348.5
		Other types	13	18.96	246.5
		Total	34		
F73	Experience of the technical personal	Buildings	21	18.05	379
		Other types	13	16.62	216
		Total	34		
F77	Adequacy of labor resources and their skills	Buildings	21	17.14	360
		Other types	13	18.08	235
		Total	34		

Table 5- 22 significance test for the difference between success factors for LBCP and others (consultants' perception).

Factor No	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Monte Carlo Sig. (2-tailed)		
					95% Confidence Interval		
					Sig.	Lower Bound	Upper Bound
F1	129.0	220.0	-0.273	**0.785**	0.798	0.791	0.806
F2	117.0	208.0	-0.725	**0.469**	0.488	0.479	0.498
F6	106.5	337.5	-1.139	**0.255**	0.281	0.272	0.290
F7	126.5	217.5	-0.381	**0.703**	0.724	0.716	0.733
F18	133.5	224.5	-0.117	**0.907**	0.980	0.977	0.982
F21	106.0	337.0	-1.178	**0.239**	0.282	0.273	0.291
F23	129.5	360.5	-0.265	**0.791**	0.776	0.768	0.785
F28	107.0	198.0	-1.165	**0.244**	0.267	0.259	0.276
F29	124.5	215.5	-0.464	**0.642**	0.681	0.672	0.690
F33	114.0	205.0	-0.851	**0.395**	0.422	0.412	0.432
F34	133.5	364.5	-0.113	**0.910**	0.937	0.932	0.942
F43	122.5	213.5	-0.530	**0.596**	0.636	0.626	0.645
F50	135.5	366.5	-0.042	**0.966**	1.000	1.000	1.000
F51	129.5	360.5	-0.282	**0.778**	0.860	0.853	0.867
F52	104.5	335.5	-1.251	**0.211**	0.292	0.283	0.301
F53	128.5	359.5	-0.309	**0.758**	0.743	0.734	0.751
F59	110.0	201.0	-0.987	**0.324**	0.361	0.352	0.370
F61	117.5	348.5	-0.730	**0.465**	0.502	0.492	0.511
F73	125.0	216.0	-0.434	**0.665**	0.712	0.703	0.720
F77	129.0	360.0	-0.288	**0.774**	.814b	0.807	0.822

All P-values for all factors are above 0.05 which means that at 95% confidence level it has been found that there is no significance different between the critical success factors for LBCP and other types of projects from the consultants' perception.

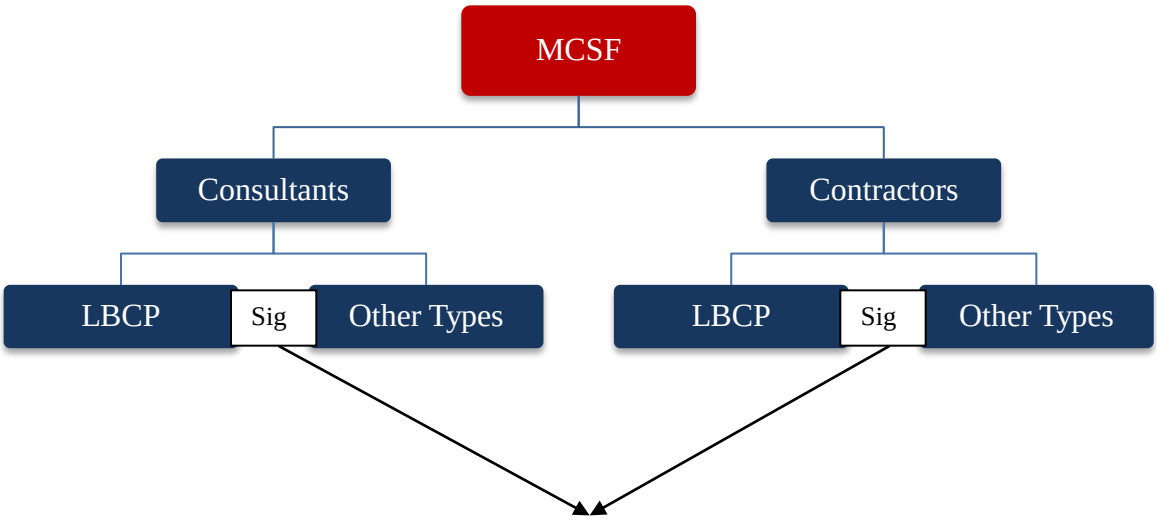
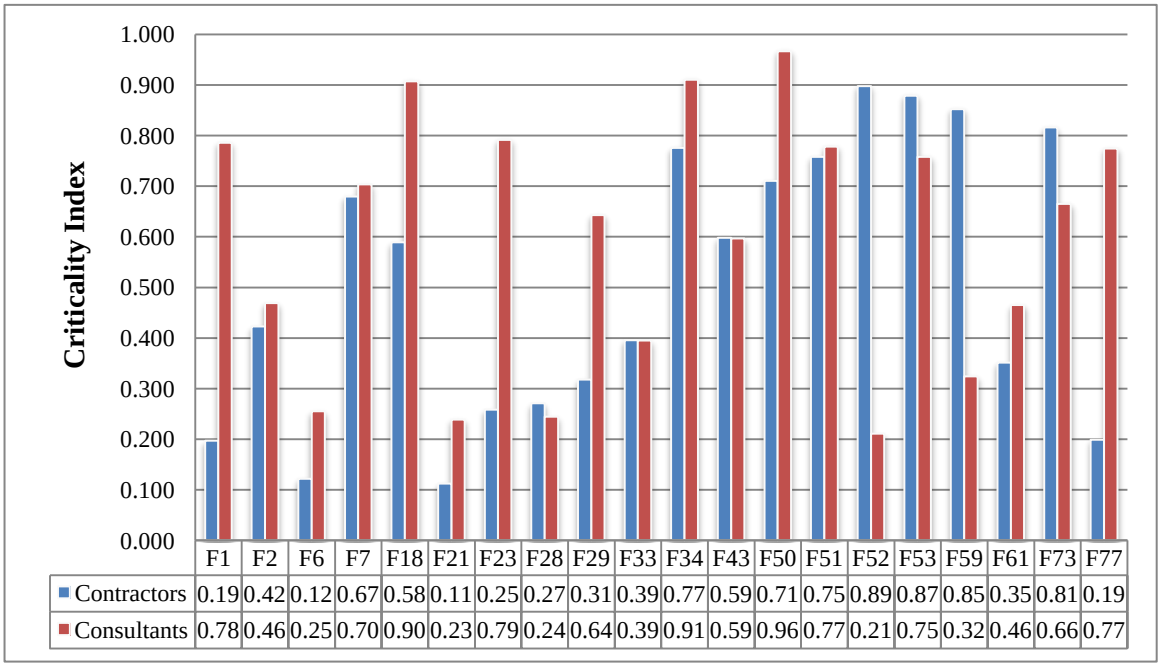


Figure 5- 4 Comparison strategy.



	F1	F2	F6	F7	F18	F21	F23	F28	F29	F33	F34	F43	F50	F51	F52	F53	F59	F61	F73	F77
Contractors	0.19	0.42	0.12	0.67	0.58	0.11	0.25	0.27	0.31	0.39	0.77	0.59	0.71	0.75	0.89	0.87	0.85	0.35	0.81	0.19
Consultants	0.78	0.46	0.25	0.70	0.90	0.23	0.79	0.24	0.64	0.39	0.91	0.59	0.96	0.77	0.21	0.75	0.32	0.46	0.66	0.77

Figure 5- 5 Comparison between the consultants and the contractor's agreement on the significance of the difference between the MCSF for LBCP and others.

Figure 5-7 shows the differences between the consultants and contractors agreement on the significance of the difference between the MCSF for LBCPs and other types of construction projects. It has been found that there is a variation in the significant level

among most of the critical factors between consultants and contractors when compare the criticality for the success factors of the LBCP with other types of projects. But overall there is no significance different on the criticality for the MCSFs between the perception of the consultants who work in LBCP and other types of construction projects. and the same result was found for the contractors.

5.6. Test statistics and comparison between contractors and consultants perception regarding critical success factors for LCP.

5.6.1. Large building construction projects (LBCP).

The hypothesis which has been tested is. There is no difference between the perception of the contractors and consultants who works on the LBCP regarding the criticality for the MCSF. Table 5-18 shows the results for the mean rank and some of ranks for both contractors and consultants who work in LBCP.

Table 5- 23 Comparison between contractors and consultants perception of the MCSF for LBCP.

No	Factor	Working Field	N	Mean Rank	Sum of Ranks
F1	The impact of the project on the public	Contractors	15	22.97	344.5
		Consultants	21	15.31	321.5
		Total	36		
F2	Technical approval authorities	Contractors	15	19.07	286
		Consultants	21	18.1	380
		Total	36		
F6	Project size	Contractors	15	23.47	352
		Consultants	21	14.95	314
		Total	36		
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	Contractors	15	19.43	291.5
		Consultants	21	17.83	374.5
		Total	36		

F18	PM competency, authority and involvement	Contractors	15	15.63	234.5
		Consultants	21	20.55	431.5
		Total	36		
F21	Capability of the client and his key personnel	Contractors	15	18.57	278.5
		Consultants	21	18.45	387.5
		Total	36		
F23	Competency and capability of the contractors' key personnel in different disciplines	Contractors	15	20.27	304
		Consultants	21	17.24	362
		Total	36		
F28	Competency and capability of the consultants' key personnel in different disciplines	Contractors	15	10.97	164.5
		Consultants	21	23.88	501.5
		Total	36		
F29	Consultant track record	Contractors	15	11.97	179.5
		Consultants	21	23.17	486.5
		Total	36		
F33	Commitment of all project participants to the established schedule and budget	Contractors	15	15.4	231
		Consultants	21	20.71	435
		Total	36		
F34	Good coordination between project participants according to the organizational chart	Contractors	15	17.93	269
		Consultants	21	18.9	397
		Total	36		
F43	Adequacy of the planning and control techniques	Contractors	15	18.37	275.5
		Consultants	21	18.6	390.5
		Total	36		
F50	Clear communication channels between the owner/PM and the designer	Contractors	15	15.8	237
		Consultants	21	20.43	429
		Total	36		
F51	Clear communication channels between the owner/PM and the contractor	Contractors	15	17.23	258.5
		Consultants	21	19.4	407.5
		Total	36		
F52	Clear communication channels between the contractor and designer/PM	Contractors	15	17.47	262
		Consultants	21	19.24	404
		Total	36		
F53	Clear communication channels between the contractor and the suppliers	Contractors	15	18.33	275
		Consultants	21	18.62	391
		Total	36		
F59	The contractor's cash flow forecast	Contractors	15	18.9	283.5
		Consultants	21	18.21	382.5
		Total	36		
F61	Construction documents management	Contractors	15	19.83	297.5
		Consultants	21	17.55	368.5
		Total	36		
F73	Experience of the technical personal	Contractors	15	19	285
		Consultants	21	18.14	381

		Total	36		
F77	Adequacy of labor resources and their skills	Contractors	15	20.7	310.5
		Consultants	21	16.93	355.5
		Total	36		

Table 5- 24 significance test for the difference between the consultants and contractors perception of the MCSF for LBCP.

Factor No	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Monte Carlo Sig. (2-tailed)		
					Sig.	95% Confidence	
						Lower Bound	Upper Bound
F1	90.5	321.5	-2.234	**0.025**	0.026	0.023	0.029
F2	149.0	380.0	-0.288	**0.773**	0.774	0.766	0.782
F6	83.0	314.0	-2.513	**0.012**	0.010	0.008	0.012
F7	143.5	374.5	-0.476	**0.634**	0.669	0.660	0.678
F18	114.5	234.5	-1.472	**0.141**	0.146	0.139	0.153
F21	156.5	387.5	-0.035	**0.972**	1.000	1.000	1.000
F23	131.0	362.0	-0.917	**0.359**	0.377	0.367	0.386
F28	44.5	164.5	-3.839	**0.000**	0.000	0.000	0.000
F29	59.5	179.5	-3.336	**0.001**	0.001	0.000	0.001
F33	111.0	231.0	-1.580	**0.114**	0.131	0.124	0.137
F34	149.0	269.0	-0.290	**0.772**	0.798	0.790	0.806
F43	155.5	275.5	-0.070	**0.944**	0.972	0.969	0.975
F50	117.0	237.0	-1.433	**0.152**	0.196	0.188	0.204
F51	138.5	258.5	-0.670	**0.503**	0.637	0.628	0.647
F52	142.0	262.0	-0.533	**0.594**	0.605	0.595	0.614
F53	155.0	275.0	-0.086	**0.932**	0.921	0.916	0.926
F59	151.5	382.5	-0.208	**0.835**	0.832	0.825	0.839
F61	137.5	368.5	-0.682	**0.495**	0.540	0.530	0.550
F73	150.0	381.0	-0.254	**0.799**	0.845	0.838	0.852
F77	124.5	355.5	-1.170	**0.242**	.245b	0.237	0.254

Table 5-19 shows P-value results for all critical factors, those values indicates that there is a significance different between the consultants and contractors perceptions who works in LBCP on the criticality for some of the success factors these factors are: **F1** (The impact of the project on the public)**, F6** (Project size) **, F28** (Competency and capability of the

consultants' key personnel in different disciplines)**, and F29** (Consultant track record)**.** P-value results are **0.025, 0.012, 0.000, and 0.001,** respectively**.** All these values are less than 0.05 which means that these values exist in the rejection area at 95% confidence level.

5.6.2. Other types of projects.

The hypothesis which has been tested is. There is no difference between the perception of the contractors and consultants who works on other types of construction projects regarding the criticality for the MCSF. Table 5-20 shows the results for the mean rank and some of ranks for both contractors and consultants who work on other types of construction projects.

Table 5- 25 Comparison between contractors and consultants perception of the MCSF for other types of projects.

No	Factor	Project type	N	Mean Rank	Sum of Ranks
F1	The impact of the project on the public	Contractors	12	14.54	174.5
		Consultants	13	11.58	150.5
		Total	25		
F2	Technical approval authorities	Contractors	12	12.92	155
		Consultants	13	13.08	170
		Total	25		
F6	Project size	Contractors	12	12.71	152.5
		Consultants	13	13.27	172.5
		Total	25		
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)	Contractors	12	14.75	177
		Consultants	13	11.38	148
		Total	25		
F18	PM competency, authority and involvement	Contractors	12	12.08	145
		Consultants	13	13.85	180
		Total	25		
F21	Capability of the client and his key personnel	Contractors	12	14.75	177
		Consultants	13	11.38	148
		Total	25		
F23	Competency and capability of the contractors' key personnel in different disciplines	Contractors	12	12.46	149.5
		Consultants	13	13.5	175.5
		Total	25		

F28	Competency and capability of the consultants' key personnel in different disciplines	Contractors	12	10.79	129.5
		Consultants	13	15.04	195.5
		Total	25		
F29	Consultant track record	Contractors	12	10.58	127
		Consultants	13	15.23	198
		Total	25		
F33	Commitment of all project participants to the established schedule and budget	Contractors	12	13.21	158.5
		Consultants	13	12.81	166.5
		Total	25		
F34	Good coordination between project participants according to the organizational chart	Contractors	12	12.12	145.5
		Consultants	13	13.81	179.5
		Total	25		
F43	Adequacy of the planning and control techniques	Contractors	12	14.21	170.5
		Consultants	13	11.88	154.5
		Total	25		
F50	Clear communication channels between the owner/PM and the designer	Contractors	12	10.42	125
		Consultants	13	15.38	200
		Total	25		
F51	Clear communication channels between the owner/PM and the contractor	Contractors	12	11.71	140.5
		Consultants	13	14.19	184.5
		Total	25		
F52	Clear communication channels between the contractor and designer/PM	Contractors	12	11.42	137
		Consultants	13	14.46	188
		Total	25		
F53	Clear communication channels between the contractor and the suppliers	Contractors	12	12.42	149
		Consultants	13	13.54	176
		Total	25		
F59	The contractor's cash flow forecast	Contractors	12	14.79	177.5
		Consultants	13	11.35	147.5
		Total	25		
F61	Construction documents management	Contractors	12	11.62	139.5
		Consultants	13	14.27	185.5
		Total	25		
F73	Experience of the technical personal	Contractors	12	13.54	162.5
		Consultants	13	12.5	162.5
		Total	25		
F77	Adequacy of labor resources and their skills	Contractors	12	15.33	184
		Consultants	13	10.85	141
		Total	25		

Table 5- 26 significance test for the difference between the consultants and contractors perception of the MCSF for other types of the projects.

Factor No	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Monte Carlo Sig. (2-tailed)		
					95% Confidence Interval		
					Sig.	Lower Bound	Upper Bound
F1	59.5	150.5	-1.036	**0.300**	0.331	0.321	0.340
F2	77.0	155.0	-0.057	**0.954**	0.952	0.947	0.956
F6	74.5	152.5	-0.201	**0.841**	0.860	0.854	0.867
F7	57.0	148.0	-1.225	**0.220**	0.257	0.249	0.266
F18	67.0	145.0	-0.638	**0.524**	0.500	0.490	0.510
F21	57.0	148.0	-1.216	**0.224**	0.261	0.252	0.269
F23	71.5	149.5	-0.397	**0.691**	0.639	0.630	0.649
F28	51.5	129.5	-1.598	**0.110**	0.093	0.088	0.099
F29	49.0	127.0	-1.714	**0.087**	0.078	0.072	0.083
F33	75.5	166.5	-0.144	**0.886**	0.925	0.920	0.930
F34	67.5	145.5	-0.602	**0.547**	0.549	0.539	0.559
F43	63.5	154.5	-0.834	**0.404**	0.489	0.479	0.498
F50	47.0	125.0	-2.048	**0.041**	0.075	0.070	0.080
F51	62.5	140.5	-0.907	**0.364**	0.364	0.354	0.373
F52	59.0	137.0	-1.136	**0.256**	0.297	0.288	0.306
F53	71.0	149.0	-0.402	**0.688**	0.693	0.684	0.702
F59	56.5	147.5	-1.227	**0.220**	0.258	0.250	0.267
F61	61.5	139.5	-1.050	**0.294**	0.285	0.276	0.294
F73	71.5	162.5	-0.381	**0.703**	0.737	0.729	0.746
F77	50.0	141.0	-1.608	**0.108**	.125b	0.119	0.132

Table 5-19 shows that there is a consensus between the consultants and contractors who works on other types of projects on the criticality for these factors except **F50** (Clear communication channels between the owner/PM and the designer) which considered critical for consultants and has low criticality for the contractors**.**

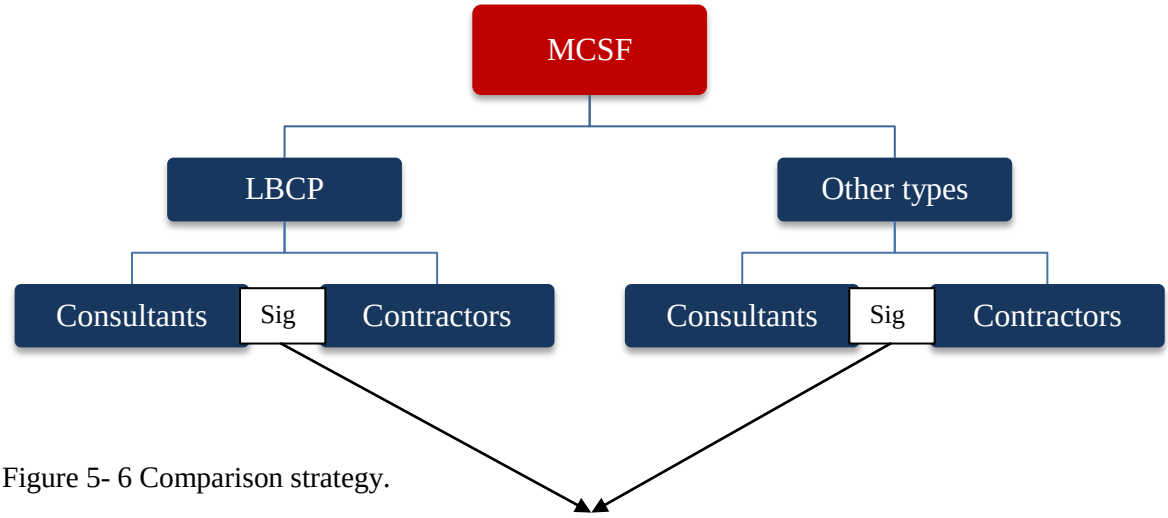
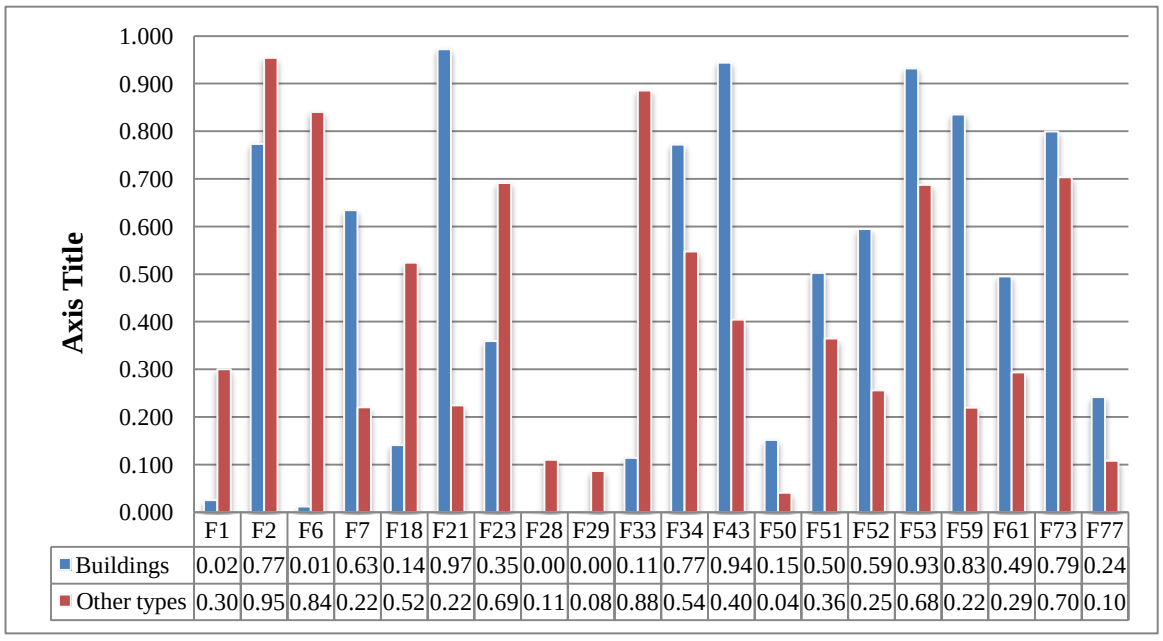


Figure 5- 6 Comparison strategy.



	F1	F2	F6	F7	F18	F21	F23	F28	F29	F33	F34	F43	F50	F51	F52	F53	F59	F61	F73	F77
Buildings	0.02	0.77	0.01	0.63	0.14	0.97	0.35	0.00	0.00	0.11	0.77	0.94	0.15	0.50	0.59	0.93	0.83	0.49	0.79	0.24
Other types	0.30	0.95	0.84	0.22	0.52	0.22	0.69	0.11	0.08	0.88	0.54	0.40	0.04	0.36	0.25	0.68	0.22	0.29	0.70	0.10

Figure 5- 7 Comparison between the LBCP and other types of projects regarding the significance of the difference in criticality for the MCSF from contractors and consultants perceptions.

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Figure 5-9 compares the agreement between contractors and consultants on the MCSF for LBCP and other types of the construction projects. And identify the significance of the different in perception between consultants and contractors for each regarding these factors. From the graph it has been found that there is a variation between the MCSF for LBCPs and other types of projects in the factors **F1** (The impact of the project on the public)**,**

F6 (Project size)**, F28** (Competency and capability of the consultants' key personnel in different disciplines), **F29** (Consultant track record)**,** and **F50** (Clear communication channels between the owner/PM and the designer)

5.7. Analyzing problematic factors.

Table 5- 27 list of problematic factors

Factor No	Factor Description
F1	The impact of the project on the public
F6	Project size
F28	Competency and capability of the consultants' key personnel in different disciplines
F29	Consultant track record
F50	Clear communication channels between the owner/PM and the designer
F77	Adequacy of labor resources and their skills

Table 5-20 shows the final results from the analysis which includes the factors which have a significant difference in perception between different groups of respondents.

1- **F1 (The impact of the project on the public)** has been found critical from the perception of the contractors who works in the buildings projects.
2- **F6 (Project size)** this factor has been found critical from the contractors perception especially who work in large buildings construction projects also.
3- **F28 (Competency and capability of the consultants' key personnel in different disciplines).** Has been found critical from the consultants' perception especially who works in large buildings construction projects.
4- **F29 (Consultant track record)** has been found critical from the consultants perception especially for those who work in Building projects.

5- **F50 (Clear communication channels between the owner/PM and the designer).** This factor has been found critical factor which affecting the success from the perception of the consultants who works in other types of construction projects.

6- **F77 (Adequacy of labor resources and their skills)** has been found critical from the contractors perception who working in all fields.

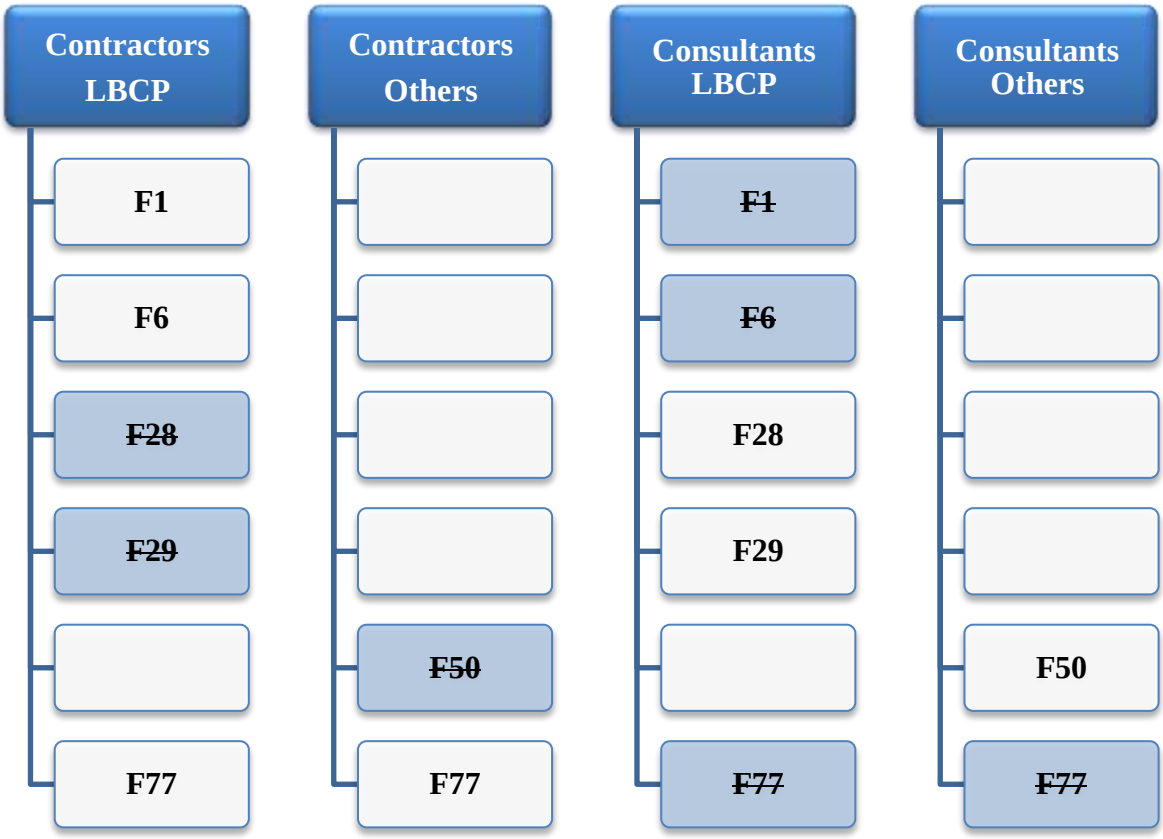

Figure 5- 8 summary for the problematic factors shows who considering the factor critical.

5.8. Discussion

One of the main objectives behind this study is to find out the most critical factors which affect the success of the construction projects. Twenty factors out of the 93 factors list have been found critical from either contractors' or consultants' perception or both. As indicated on Table 5-23 some of these critical factors have been found critical on other studies which have been conducted in different countries. Based on the frequency of these factors we can conclude the level of consensus over these factors.

Factors which have been found critical in most of the previous studies are, Competency and capability of the contractors' key personnel in different disciplines, PM competency, authority and involvement, Realistic obligations/clear objectives (Clear Vision, Mission and Goals), and Project size.

Also communication channels between different parties have been found critical, but this study focus on this factor and found illustrate these channels which are: Clear communication channels between the owner/PM and the designer, Clear communication channels between the owner/PM and the contractor, Clear communication channels between the contractor and the suppliers, and Clear communication channels between the contractor and designer/PM.

Factors which have been found critical in some of the previous studies are: Technical approval authorities, Adequacy of labor resources and their skills, Competency and capability of the consultants' key personnel in different disciplines.

Few studies indicated Commitment of all project participants to the established schedule and budget, Adequacy of the planning and control techniques, Experience of the technical personal, and the contractor's cash flow forecast as critical success factors.

Only this study indicated that (Good coordination between project participants according to the organizational chart, Construction documents management, Capability of the client and his key personnel, Consultant track record, and The impact of the project on the public,) are critical on the project success.

These factors have a great effect on the achievement on the construction project objectives such as on time, within budget and according to the required quality. Each factor has a specific effect on one of these goals. For example Hwang, et al (2013) was found that adequate planning and control technique and realistic obligations has an effect on the cost, schedule and quality. While factor like Capability of contractor key personal found that have an effect on the schedule only.

Another issue has been noticed in this study that both consultants' and contractors did not considered safety and quality factors as critical success factors this means that there is an expected problem in the safety issues in addition to the quality inspection.

Table 5- 28 comparing The MCSF in this study with others.

Factor No	Country / The Most critical success factors	KSA			Not mentioned			Not mentioned			Singapore			UK			USA. UK KSA. UAE		
		C	S	B	C	S	B	C	S	B	C	S	B	C	S	B	C	S	B
		This study			Kog et al. (2012)			Chua et al. (1999)			Hwang et al (2013)			Alzahrani, et al (2013)			Inayat, et al (2013)		
F23	Competency and capability of the contractors' key personnel in different disciplines			***X***			X			X							X		
F18	PM competency, authority and involvement			***X***			X			X							X		
F50	Clear communication channels between the owner/PM and the designer		***X***																
F33	Commitment of all project participants to the established schedule and budget			***X***								X							
F51	Clear communication channels between the owner/PM and the contractor			***X***															
F34	Good coordination between project participants according to the organizational chart			***X***															
F53	Clear communication channels between the contractor and the suppliers			***X***															
F43	Adequacy of the planning and control techniques			***X***								X							
F61	Construction documents management			***X***															
F52	Clear communication channels between the contractor and designer/PM			***X***															
F2	Technical approval authorities			***X***			X										X		
F73	Experience of the technical personal			***X***											X				
F77	Adequacy of labor resources and their skills	***X***													X		X		
F59	The contractor's cash flow forecast			***X***											X				
F7	Realistic obligations/clear objectives (Clear Vision, Mission and Goals)			***X***			X			X		X					X		
F28	Competency and capability of the consultants' key personnel in different disciplines		***X***								X						X		
F21	Capability of the client and his key personnel			***X***															
F29	Consultant track record		***X***																
F6	Project size	***X***					X								X		X		
F1	The impact of the project on the public	X																	

CHAPTER 6

Conclusions & Recommendations

6.1. Conclusions

1. From the literature review 93 factors which affect the success of the construction projects have been selected from the most important factors analyzed in previous researches. These factors are belonged to eight main categories as following: Project characteristics, Contractual arrangement and administration, Project participants, Interactive process and communication. Finance, Management and technical attributes, Experience and resource attributes, Health & quality attributes.

2. Twenty factors have been nominated as the MCSF from the consultants' as well as contractors' perceptions depending on the criticality index for each factor from each perception. These factors are: Competency and capability of the contractors' key personnel in different disciplines, PM competency, authority and involvement, Clear communication channels between the owner/PM and the designer, Commitment of all project participants to the established schedule and budget, Clear communication channels between the owner/PM and the contractor, Good coordination between project participants according to the organizational chart, Clear communication channels between the contractor and the suppliers, Adequacy of the planning and

control techniques, Construction documents management, Clear communication channels between the contractor and designer/PM, Technical approval authorities, Experience of the technical personal, Adequacy of labor resources and their skills, The contractor's cash flow forecast, Realistic obligations/clear objectives (Clear Vision, Mission and Goals), Competency and capability of the consultants' key personnel in different disciplines, Capability of the client and his key personnel, Consultant track record, Project size, and The impact of the project on the public.

3. The most important categories for the factors which considered most critical form the contractors' perception are: Project characteristics, Project Participants, Interactive processes and communication, financial Attributes, management and technical attributes, Experience and Resource attributes and contractual arrangements and administration. And there is no criticality for the last category which is the risk attributes on the project success.

   From the consultants perception only Project Participants and Interactive processes and communication are critical.

   By general comparison between contractors' and consultants' perceptions regarding the MCSF they agreed on the criticality of the Project Participants, and Interactive processes and communication. This means that investment in people is one of the most important and critical procedures which should be adopted to increase the probability of the project success. Also different methods which lead to prober communication between different parties involved in the construction process are crucial and have great effect on the project success.

4. From the analytical study results shows that there is no significance different between the MCSF for LBCP and other types of projects from the consultants' perception as well as contractors' perception.

5. The following factors considered problematic because of the difference in the construction practitioners opinion regarding their criticality. There is difference between the consultants and contractors perceptions who work in LBCP regarding the criticality of the following factors: "The impact of the project on the public" and "project size" are considered critical from the contractors' perception, while "competency and capability of the consultants' key personnel in different disciplines" and "consultant track record" are considered critical from the consultants' perception. Also clear communication channels between the owner/PM and the designer, is critical from the perception of the consultants who work in other types of construction projects. and finally, "adequacy of labor resources and their skills" is considered critical for all contractors, were consultants doesn't care about its criticality.

6.2. Recommendations

Since the success of the construction project is general objective; all parties who involved in the construction process should participate in achieving the success. And as the meaning of the success means different things to different people, all should understand what dose success means for others. And also the factors which have a critical effect on the success should be taken in consideration by all parties.

1. The MCSF should be understood carefully by all parties involved in the construction process.
2. Factors which have a consensus between different project participants should be used as a base in any negotiation process or any partnering relationship. This will enhance the success of any relationship which increases the success probability for the project.
3. Other factors which have differences in their criticality based on different participants' perceptions should be studied deeply in workshops to increase the awareness for all participants regarding the importance of these factors.

6.3. Future studies.

1- Further studies which include owners and PM as third party should be conducted on a brief list. This is to include all parties in the study.

2- The Problematic factors should be studied deeply to find the reason behind the variation between consultants' and contractors' perceptions. In addition to reduce the gap between different perceptions.

3- The managerial level which is responsible to adopt each of these factor should be identified to facilitate controlling these factors which lead to control the project success.

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APPENDEX

بسم الله الرحمن الرحيم

Ministry of Higher Education
King Fahd University of Petroleum & Minerals
COLLEGE OF ENVIRONMENTAL DESIGN
Dept. of Construction Engineering & Management

وزارة التعليم العالي
جامعة الملك فهد للبترول والمعادن
كلية تصاميم البيئة
قسم هندسة وإدارة التشييد

Invitation Letter

Dear Respondent,

The Construction Engineering and Management Department of the College of Environmental Design at King Fahd University of Petroleum & Minerals is presently engaged in a study that will help to understand the consultant and contractor perception of the success factors for large construction project.

We are asking your engineers to participate by answering the questionnaire related to this study. It is your choice to fill this survey and all data will be used only for research purposes. The questionnaires will take less than 20 minutes of your valuable time. Your contribution in this regard is highly appreciated and it will be pleasure for us to share the results of this research with you.

Thank you in anticipation for your cooperation.

Sincerely yours,

Dr. Khalaf A. Al-Ofi
Department Chairman
Construction Engineering and Management

الظهران ٣١٢٦١ • المملكة العربية السعودية • تلفون : ٨٦٠-٣٥٩٠ (٠٣) • فاكس : ٨٦٠-٤٠١٩ (٠٣)
DHAHRAN 31261 • SAUDI ARABIA • Telephone: (03) 860-3590 • Fax: (03) 860-4019

Figure A. 1 invitation letter to participate in the survey.

Table A. 1 Questionnaire survey.

بسم الله الرحمن الرحيم					
Dear Participant, This survey will be used only for research proposes and all information collected from you will be kept confidential. This research aims to identify the most critical success factors for large building construction projects from the contractors ' and the consultants' perspectives. The results can aid to differentiate between the perceptions of the project participants regarding these success factors and facilitate the development of a list for consensus factors to increase the success probability for large building construction projects. Thanks for your cooperation.					
Firm's Name					
Working Field	Contractor		Consultant		Owner
Classification in case of contractor	1	2	3	4	5
Projects Type	Building		Engineering		Industrial
Respondent name / (Optional):					
Position:					
Experience / Years:					
Experience in KSA / Years:					
Nationality:					
Contact E-mail: and fax number:					

Table A. 1 Questionnaire survey. (cont).

Scale Meaning				
1 = Very Low Effect	2 = Low Effect	3 = Intermediate effect	4 = High Effect	5 = Extreme Effect

No	Category	Success	1	2	3	4	
	Project characteristics						
1		The impact of the project on the public					
2		Technical approval authorities					
3		Adequacy of the allocated funds					
4		Site limitations and location					
5		Use of constructability analysis					
6		Project size					
	Contractual arrangements and administration						
7		Realistic obligations/clear objectives (Clear Vision, Mission and Goals)					
8		Adequacy of plans and specifications					
9		Formal dispute resolution process					
10		Motivation/incentives					
11		Competition strategy					
12		Organizational chart					
13		Comprehensive of the site investigation before tendering					
14		Impartiality in awarding bids to the right designer/contractor					
15		General tolerance to corruption					
16		Little change in client's requirements during construction					
17		Thorough assessment of the contractor's proposal					

Table A. 1 Questionnaire survey. (cont).

No	Category	Success	1	2	3	4	
	Project Participants						
18	Project Manager	PM competency, authority and involvement					
19	Client	Client experience in dealing with construction projects					
20		Client's understanding of the scope of work before advertising for bids					
21		Capability of the client and his key personnel					
22		Client track record					
23	Contractor	Competency and capability of the contractors' key personnel in different disciplines					
24		The contractor's understanding of the design process					
25		Contractor track record					
26	Designer	The architect's capability for achieving the client's requirements within budget and schedule					
27		Skillful guidance and advice from the architect					
28		Competency and capability of the consultants' key personnel in different disciplines					
29		Consultant track record					
30	Suppliers	Competency and capability of the suppliers' key personnel in different disciplines					
31		Supplier track record					
32	End user	Full understanding of the end users' requirements					
33	Project	Commitment of all project participants to the established schedule and budget					
34	participants	Good coordination between project participants according to the organizational chart					
35		Development of an agreed upon framework for executing the project					
36		Clarity of the stakeholders roles					
37		Balance of the different stakeholders requirements					
38		Sharing of common project goals among all project participants					
39		Sharing of a clear understanding of functional and technical requirements among all project participants					
40		Sharing of a high degree of trust between all project participants					
	Interactive processes and communication						
41	Feedback	Monitoring and feedback on the project					
42		knowledge feedback from the contractor to the design team					
43	Control of	Adequacy of the planning and control techniques					
44	process	Establishment of monitoring and approval mechanisms for design changes					
45		Sufficient details on the working drawing documents					
46		Establishment of a mechanism for updating the budget					
47		Establishment of a mechanism for updating the schedule					
48		Establishment of a mechanism for reporting progress					
49		Initial overuse of CPM/PERT					
50	communication	Clear communication channels between the owner/PM and the designer					
51		Clear communication channels between the owner/PM and the contractor					
52		Clear communication channels between the contractor and designer/PM					
53		Clear communication channels between the contractor and the suppliers					
54	Meetings	Design control meetings					
55	and	Construction control meetings					
56	Decision	Proper priority setting					
57	making	Good record of the made decisions					

Table A. 1 Questionnaire survey. (cont).

No	Category	Success	1	2	3	4	
	Financial Attributes						
58		Bonding capacity of the contractor					
59		The contractor's cash flow forecast					
	Management and technical attributes						
60		Site organization					
61		Construction documents management					
62		Usage of IT tools during the project life cycle					
63		Technical capability of the project participants					
64		Knowledge of a particular construction method					
65		Establishment of maintenance plans					
	Experience and Resource attributes						
66		Type of past project completed					
67	Experience	Size of past project completed					
68	and	Experience of the project participants in the region					
69	Organization	Size of the company					
70	attributes	Company image (reputation)					
71		Age in business					
72		Litigation tendency					
73		Experience of the technical personal					
74	Resources	Number of full time employees					
75	attributes	Cultural environment for the employee					
76		Recruitment and training procedures					
77		Adequacy of labor resources and their skills					
78		Adequacy of plant resources					
	Risk attributes						
79	Health and	Past health and safety records					
80	Environmental	Occupational safety and health administration (OSHA) rating					
81	attributes	Waste disposal during construction					
82		Materials and substances used in the project					
83		Political risks					
84	Risk	Economic risks					
85		Risk identification and allocation					
86		Understanding and acceptance of the risk and legal liability by all project participants					
87		Force majeure					
88		Latent site conditions					
89		Application of total quality management training					
90		Usage of international quality and safety standards					
91	Quality	Implementation of quality control measures					
92	attributes	Establishment of quality policies in the construction firm					
93		Implementation of quality assurance measures					

Table A. 1 Questionnaire survey. (cont).

No	Category	Suc	1	2	3	4	
Other expected success factors from your opinion (and their rank)							

Comments on the research

Researcher Contact Information

Name : Eng. Hasan Osama Mathar

Supervisor : Professor. Sadi Assaf

Researcher E-mail address:

arch.mathar@gmail.com Supervisor E-mail

address: assaf@kfupm.edu.sa Mobile

number: 00966548491304

Vitae

Personal information.

Name : Hasan Osama Mathar

Mobile Number : 00970599221104

Email : arch.mathar@gmail.com

Nationality : Palestinian

Date of Birth :8/31/1987

Address : Palestine – Nablus – Almakhfiah – Granada building.

Certificates

I was graduated from Al-Salahia Secondary school – Nablus – Palestine, in 2005 **scientific division with grade 93.1 %.**

After graduated from the secondary school I was joined AN-Najah National University – Nablus – Palestine, to study the **Architectural Engineering from 2005 up to 2010.**

Two years of academic work at AN-Najah National University has been accomplished as **teaching assistant from 2010 - 2012**.

In 2012 I got the chance to continue my education at KFUPM in the department of Construction Engineering and Management, and this is my thesis which considered the final requirement to get the degree of **Master of science in construction Engineering and Management**.

Publications.

Tow journal papers will be submitted in the near future from the thesis work.